ENGINEERING AND MINING JOURNAL

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OCTOBER 1956

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FOUNDED 1866

NEW ERA IN NICKEL

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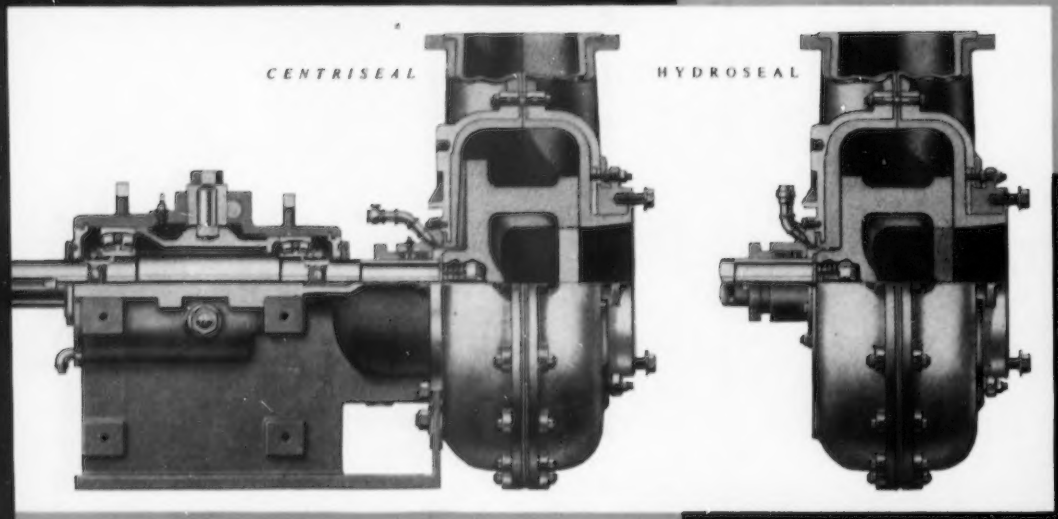
Rich Dividends Piled Up When Idarado Made a Change ... p 104

How much alike are these two pumps?

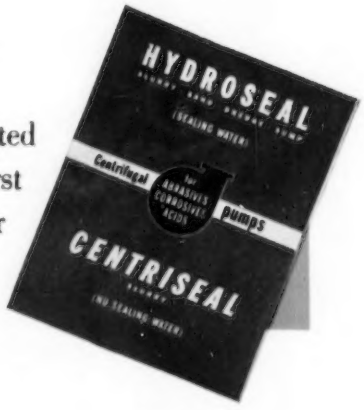


The fact is, these two Slurry pumps are identical except their rubber impellers and rubber engine-side shell half-liners.

The Centriseal, operating without sealing water, is much in demand in both mining and processing where abrasive or corrosive pulp must be delivered *undiluted.*

The Hydroseal is the re-designed Slurry member of the Hydroseal line of mechanically-efficient pumps that have been cutting production costs in mining fields for years, including the Hydroseal Sand, Dredge and Sump pumps.

The above cut-away illustration is from a newly printed exposition of the complete A-S-H line. Take this first step toward improving your pumping of abrasives or corrosives . . . write to us for **Brochure No. 956.**



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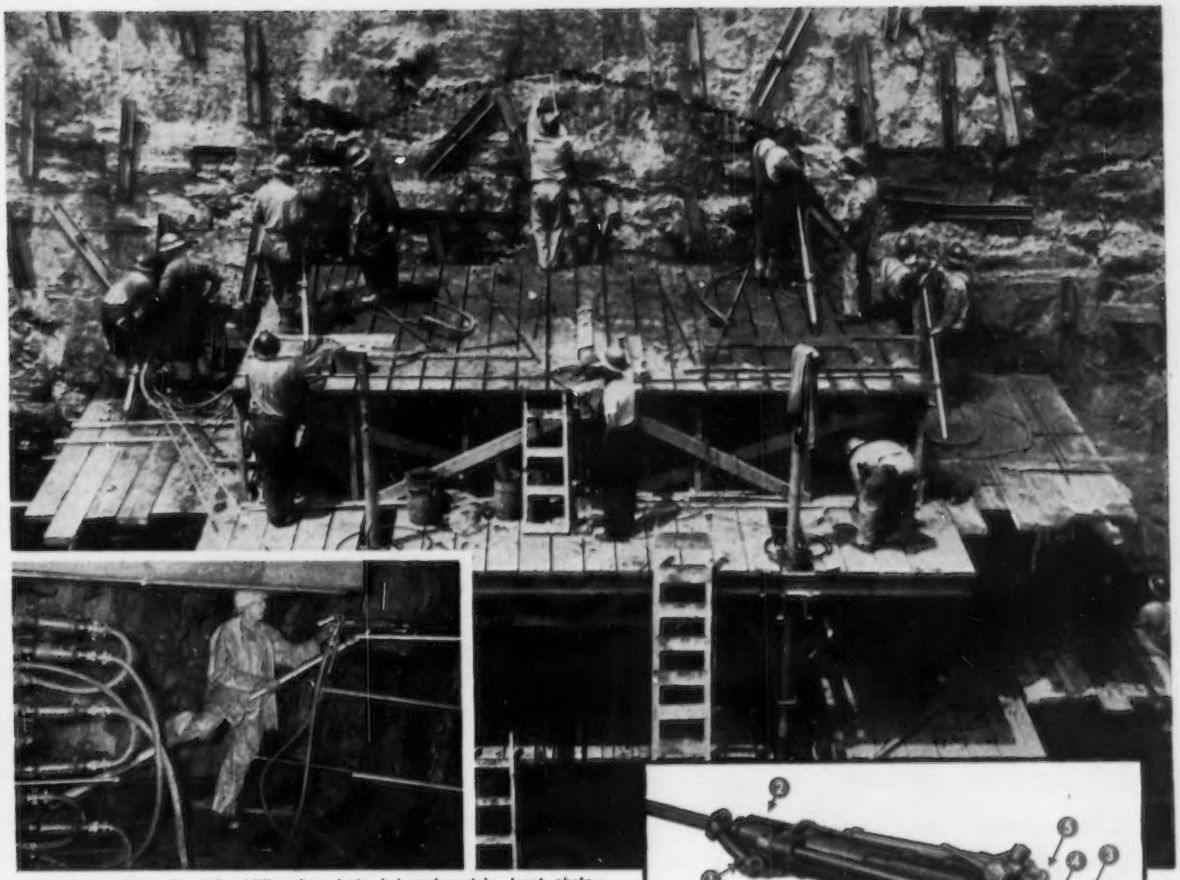

Photo shows line-hole drilling for start of tunnel portals. Inset photo shows close up of Jackdrill in action.

I-R JACKDRILLS DROVE NEW LINCOLN TUNNEL APPROACH

USING a top heading method and Ingersoll-Rand Jackdrills, the western approach to the new Lincoln Tunnel tube was driven through 700 ft. of rock with no delays and with the drilling synchronized to the mucking cycle.

Up to eight lightweight Jackdrills with air-leg feeds were used at the same time on the jumbo. Manifolding of air and water simplified shifting of the drills. The 115 holes for each shot were drilled 15 ft. deep, using 1⅛" Carset Jackbits and only one steel change.

This is another example of the versatility and ease of operation that have made I-R Jackdrills first choice with owners and operators alike, on mining and tunneling jobs all over the country. With the improved features of the new model JR38-B; the I-R Jackdrill will set still higher standards of performance and economy. Ask your I-R representative for complete details.

NEW JR38-B JACKDRILL has 7 improved features

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3. **Reversible roll-type feed control handle**
4. **Simplified water-tube replacement**
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ENGINEERING AND MINING JOURNAL

90th YEAR OF PUBLICATION

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LETTERS

"New" Technique Not So New

I was interested in the article which appeared in the August 1956 issue of *Engineering & Mining Journal*, page 112 entitled "New Freezing Technique Insures Drill Core Recovery," which states that the new method was developed by Jack Bailey, Utah Construction Co. project engineer, and Dean Anderson, chief geologist, et al.

The method was conceived by me when we were drilling a fluorite prospect in sub-zero weather at a Bureau of Mines project in Vermont during the winter of 1944. Drilling progress was practically nil because of delays due to the water freezing in the drilling circuit. I decided to substitute kerosene for water in the circuit to overcome this trouble and found that not only the freezing difficulty was overcome but that while drilling through the overburden to bedrock the core recovery of overburden was almost perfect and no difficulty was experienced with the hole caving. Because the overburden was only several feet deep on this deposit it was decided to really test the idea at another Bureau of Mines project in New York State where the drilling was through 50 to 110 feet of overburden to bedrock in a swamp. The method worked fine and was used throughout the project. The method is explained briefly in *Diamond Drill Handbook* by J. D. Cumming, published in 1951, pages 135-145.

Admittedly, the cost is high but the results are near perfect. At the time, kerosene seemed preferable to diesel fuel oil.

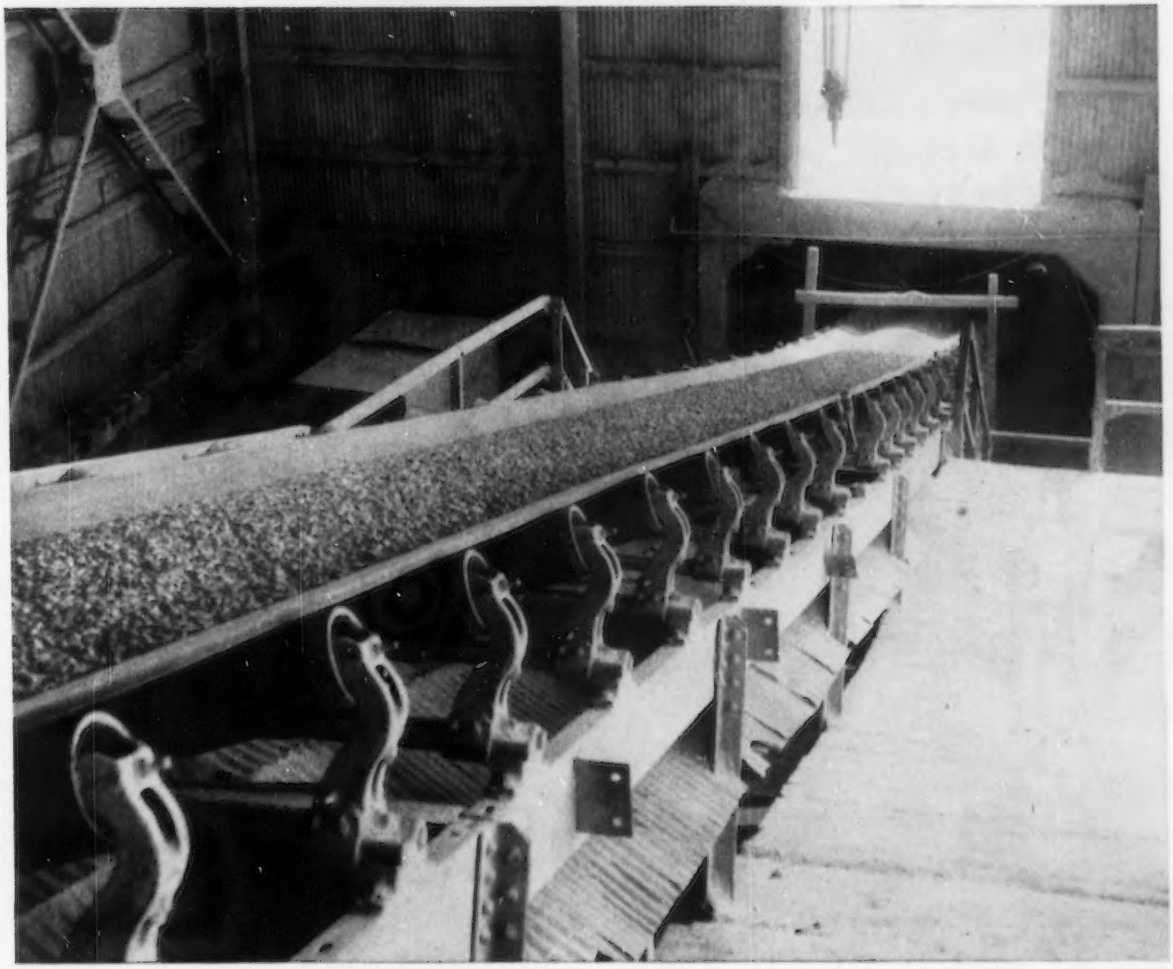
Since the method was developed at Bureau of Mines expense, I naturally was required to assign my United States patent to the Department of Interior; however, I obtained patents in both Canada and Australia.

Another, perhaps equally important application is the substitution of kerosene or diesel fuel oil for water in the conventional diamond drilling rig during sub-zero weather. This substitution obviates such adverse conditions as freezing water pipes, time and expense lost in building fires about pumps and elimination of hauling water to drill sites where water is not available. In many instances, the expense of lost time probably would be less than the cost of the oil and would also permit shut-downs of indefinite length, whether the drilling be in placer ground, overburden or solid rock.

I simply bring this matter to your attention to point out that this method of drilling is not new.

John D. Bardill
Spokane, Wash.

B.F.Goodrich



85 million tons handled at belt cost of 9¢ per 1000 tons

MORE than 85 million tons of copper ore have ridden that B. F. Goodrich conveyor belt since it was first installed 17 years ago at the Chile Exploration Company, Chuquicamata, Chile.

In all that time the belt has cost the company less than $180 for repairs. And the company reports it still looks good for two more years! Here are some of the reasons for the long life, low maintenance costs.

The square-edge construction, found only in B. F. Goodrich belts, insures greater flexibility, helps the belt travel more easily, with less strain, less wear. This is because each ply of fabric runs only from one edge of the belt to the other. Edges are bonded, won't separate. Belt troughs perfectly whether loaded or empty.

Special chemicals, developed by B. F. Goodrich, are added to the rubber to keep it "live" and elastic, help it resist the effects of age, sun and weather. Belts are made under uniform tension, so that all fibers work together; seamless plies are used to avoid weak spots; patented layers called "breakers" are added to stand hard blows; mildew treatment is included to protect fabric.

This is why so many B. F. Goodrich belts—like the one in the picture—have far outlasted other medium-priced belts, and have cut the costs of hundreds of industrial operations. Let your B. F. Goodrich distributor show you how to get the best conveyor belt service for the lowest possible cost. *B. F. Goodrich Industrial Products Company, Dept. M-751, Akron 18, Ohio.*

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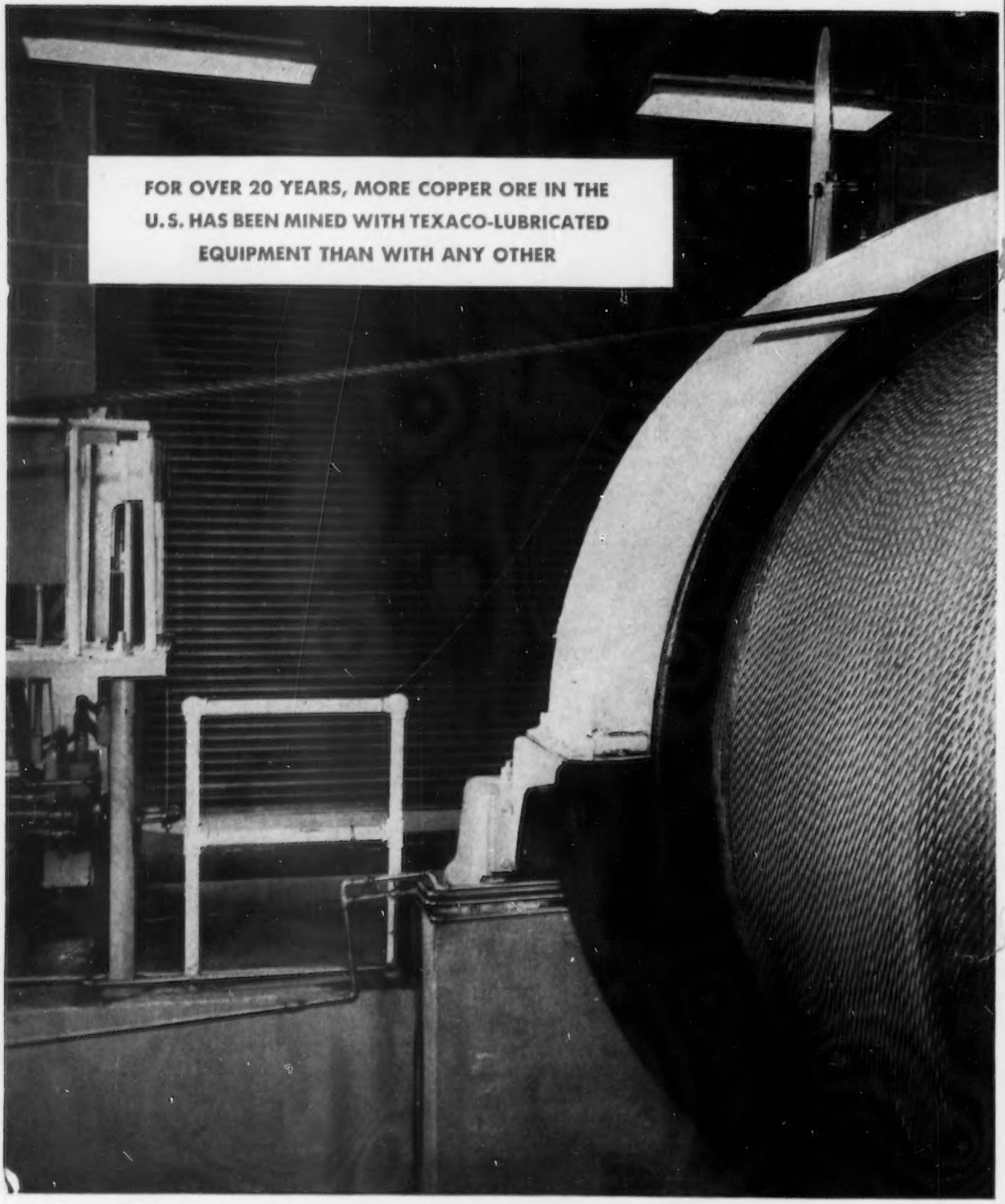
INDUSTRIAL PRODUCTS



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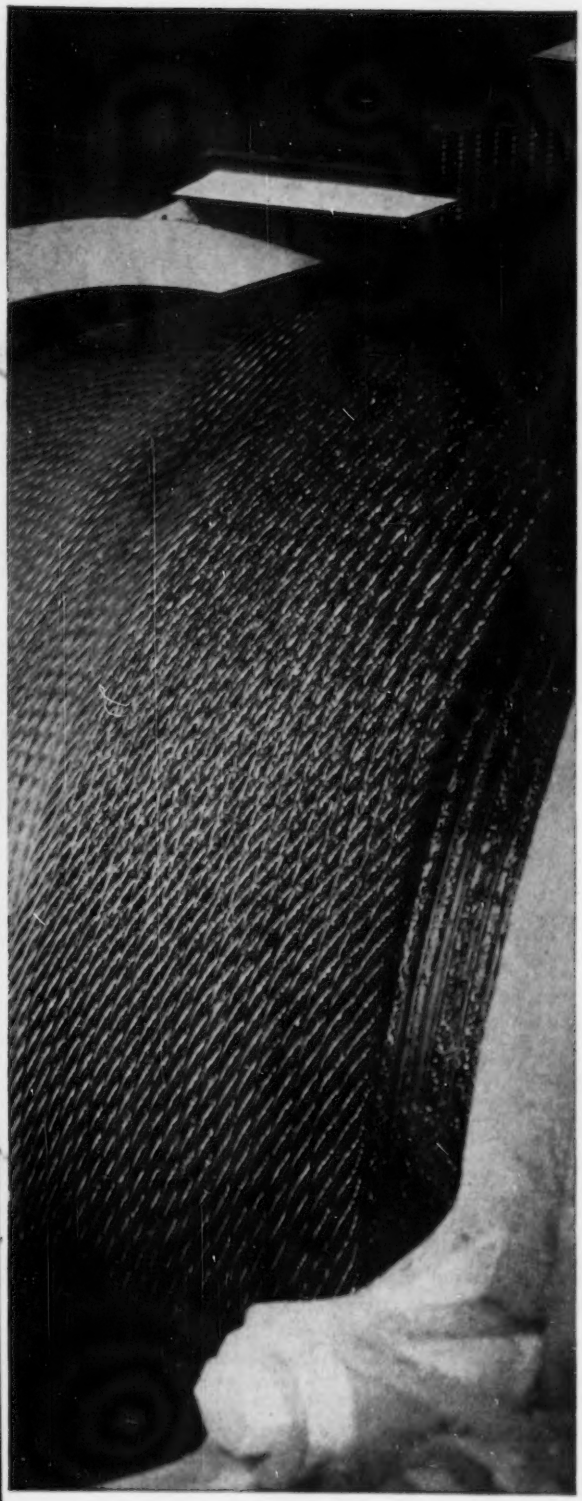


Here's how to keep wire rope strong longer

Wire rope experts will tell you that the way to keep rope strong longer is to prevent rust and wear. Use *Texaco Crater*—the penetrating lubricant that not only protects the metal strands against wear and rust, but surrounds and preserves the core. Your rope lasts longer, your maintenance costs come down.

On open gears, *Texaco Crater* also does a great job. Its ability to adhere to the teeth means lasting protection against shock loads and heavy service . . . greatly reduced wear and longer gear life.

For those who want the added convenience of fluid application, there is *Texaco Crater X Fluid*—it *goes* on as a liquid, *stays* on just like regular *Crater*. Protects both wire rope and open gears.

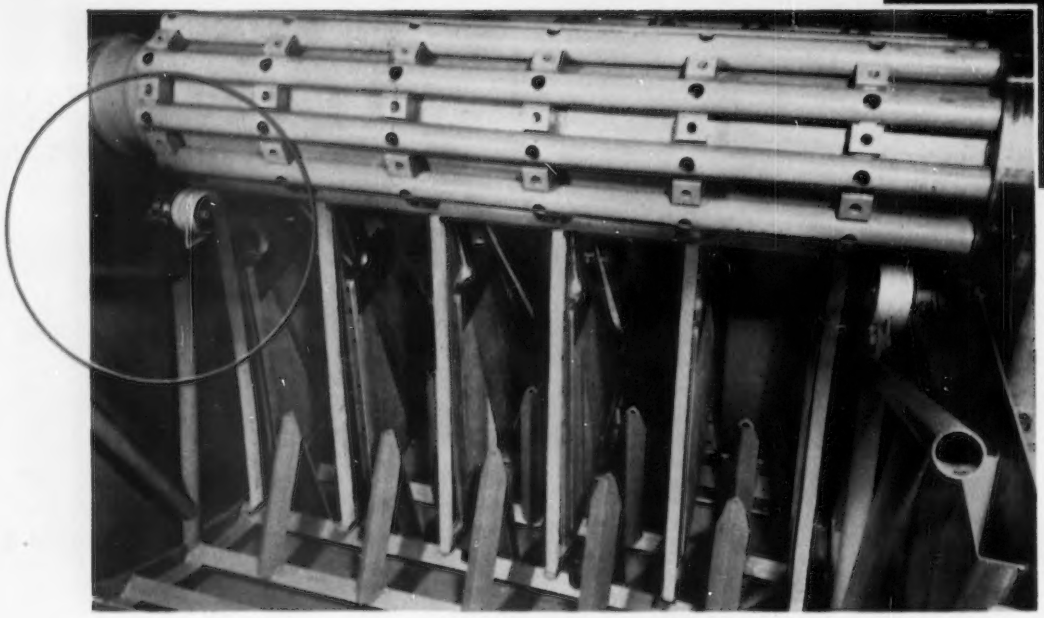
For mine car wheels, use *Texaco Olympian Grease*—ideal for plain, anti-friction or cavity hub bearings. You'll get longer lasting protection and easier starts around the calendar.

A Texaco Lubrication Engineer will gladly help you select the proper lubricants for all your equipment. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

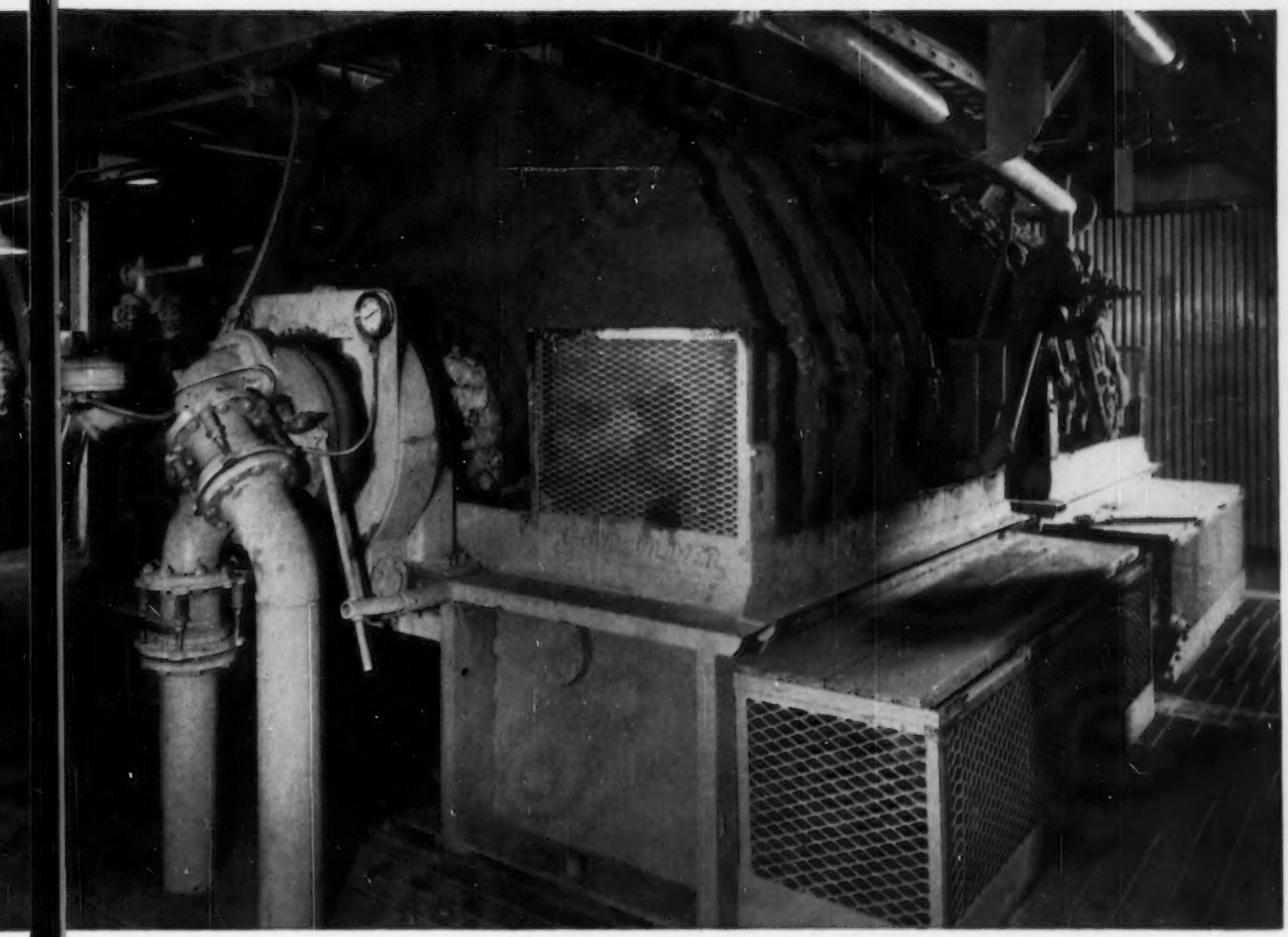
The Texas Company, 135 East 42nd Street, New York 17, N. Y.

Lubricants and Fuels
FOR THE MINING INDUSTRY

New Swing-Type Agitator on AMERICAN FILTER



Closeup of the new agitator installed in Filter Tank. Torsion bearings are at left and right just under the main shaft.



Four American Filters equipped with torsion-bearing, swing-type agitators at a large Eastern cement mill. Each unit handles 765,000 pounds of slurry per 24 hours.

Latest development in continuous disc filters is a new swing-type agitator designed by Dorr-Oliver that completely eliminates troublesome stuffing boxes and assures uniform agitation from the bottom of the tank to the slurry surface. Here's how it works.

Vertical picket members are attached to the agitator. These pickets extend up between the filter discs and insure positive, uniform agitation throughout the feed slurry. Torsion bearings located on the inside of the tank walls support the agitator. These bearings incorporate a special rubber compound, bonded to the bearing support and agitator shaft, that flexes as the shaft oscillates. It is impossible for slurry to enter the bearing.

This new development is typical of Dorr-Oliver's continuing search for improved techniques in wet processing. If you'd like more information on the American Filter with the new swing-type agitator, just drop a line to Dorr-Oliver Incorporated, Stamford, Connecticut.

American T.M. Reg. U. S. Pat. Office

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switches at rail-head

SwitchTractor at uranium mine cleans-up pit-floor, spots rail-cars

At rail terminal, Anaconda SwitchTractor quickly spots string of ore cars in-between dozing chores. Versatile rubber-tired machine can move 5 loaded or 18 empty cars up a 1 per cent grade...is not tied to tracks as expensive switch engines are.

Cleaning up on ledge, SwitchTractor dozes loose material over bank to shovel below. Note standard railroad coupler on rig. It can speed from pit, plant or dump to car-spotting location as needed. It reaches a job site a mile away in less than five minutes.

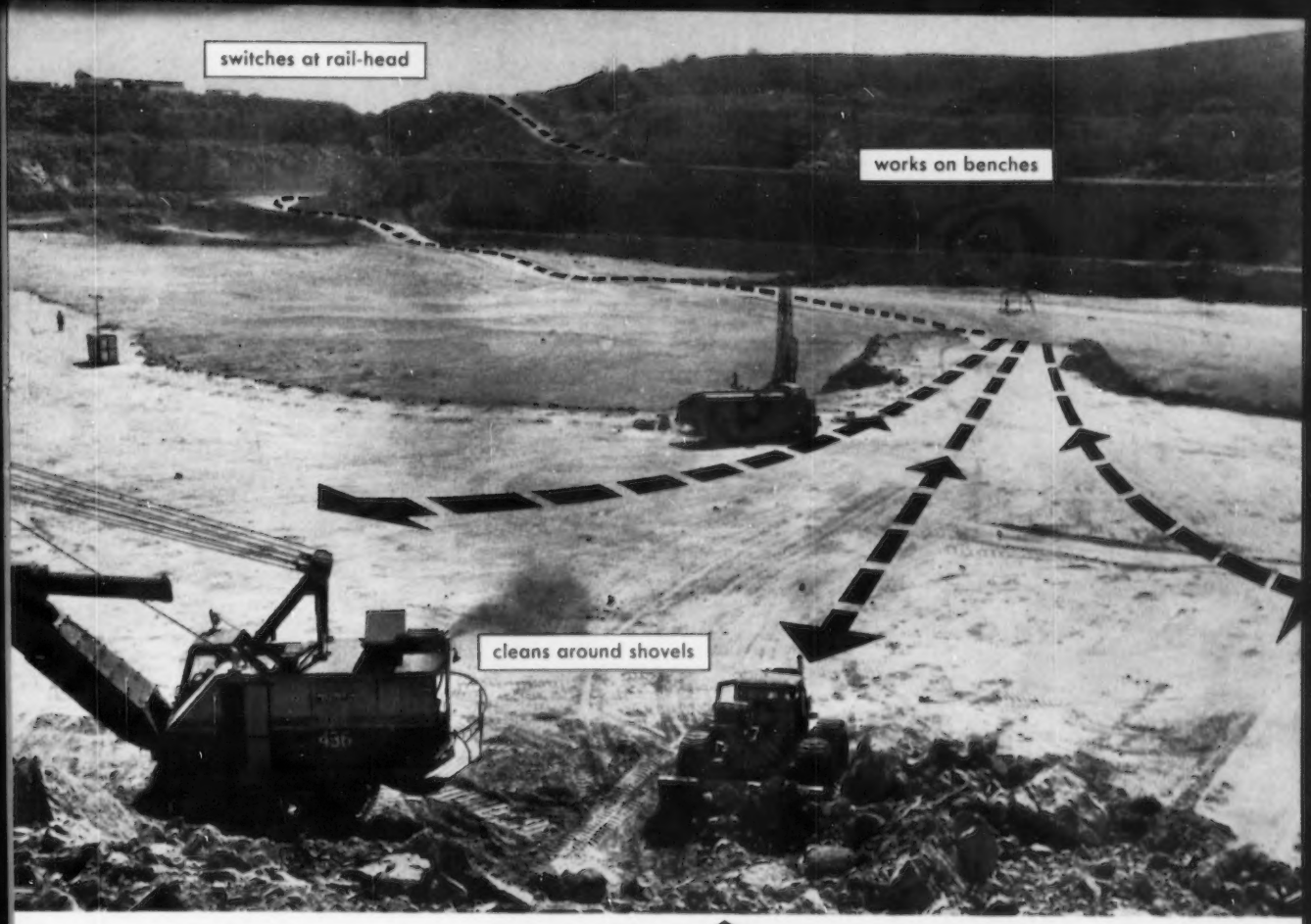
In the New Mexico desert, 40 mi. west of Albuquerque, The Anaconda Company operates the Jackpile Mine — a large open-pit uranium mine. Ore-bearing rock is loaded into a fleet of 19 dump-trucks by 4 mining shovels.

Anaconda uses a fast, rubber-tired LeTourneau-Westinghouse SwitchTractor to spot ore-cars at the mine. The tractor also "keeps house"—dozes, hauls, and cleans-up debris over many miles of mine-ledges, pit-floors, and haul-roads on a daily basis.

Best feature of this versatile rubber-tired SwitchTractor is that it never stands idle during slack periods at the rail-head. When not needed as a switcher, rig cleans-up around shovels, pushes in toes of stockpiles, hauls equipment trailers, patrols pit-floors and haul-roads.

Mobility pays off

On a widespread operation like the Jackpile Mine, distance is a great obstacle. Speedy SwitchTractor can run to the next task fast *under its own power.* SwitchTractor's big, low-pressure rubber tires absorb the pounding and grinding of mine-work without damage. Around pit and plant the machine's big deep-lug tires are constantly rolling over rock and abrasive materials without damage or unusual wear.



Sketched lines show range of SwitchTractor at Anaconda's New Mexico Mine. In foreground, rubber-tired tractor cleans-up around a shovel. It dozes over entire pit-floor and on benches bordering the excavation. Railhead is only a few minutes drive away.

Heavy-duty tractor

SwitchTractor is a heavy-duty tractor that can doze 2½ to 3 yards per pass. Rig's weight with blade is close to 16 tons; hydroflation (inflating tires with water) increases weight by another 10 per cent for added traction, on any surface.

"Pleased with its flexibility"

"We're pleased with the flexibility of the SwitchTractor," stated John P. Herndon, superintendent of mines. "Its ability to move fast from place to place on a scattered operation is of great value." Operator Lorenzo Reed said, "It's fast and easy to run."

What is a SwitchTractor?

Basically, it's the well-known LeTourneau-Westinghouse 208 hp Tournatractor, equipped with a standard railway car-coupler on the rear.*

What will it do for you?

SwitchTractor will give you rubber-tired mobility in car-spotting plus handling heavy-duty hauling and dozing jobs. Tractor has more push-or-pull power than ordinary rubber-tired switchers. It saves switching time because it isn't tied to tracks like a switch engine. It does the work of a switch engine, but doesn't cost as much to buy or operate. It goes anywhere with its big, low-pressure tires that roll over tracks, ties, switches, ballast, curbs and paving without damage.

We'll be glad to survey your switcher and tractor problems and give you a specific report on advantages of a 208 hp, 17 mph SwitchTractor on your operation. No obligation. Why not write with brief description of your problem?

**If you already own a Tournatractor, it can easily be equipped with a car-coupler for double-duty SwitchTractor service on your sidings, yard, or pit tracks. Ask for details.*

Tournatractor—Trademark Reg. U.S. Pat. Off.; SwitchTractor—Trademark ST-1071-M

LeTourneau-**WESTINGHOUSE** Company, PEORIA, ILLINOIS

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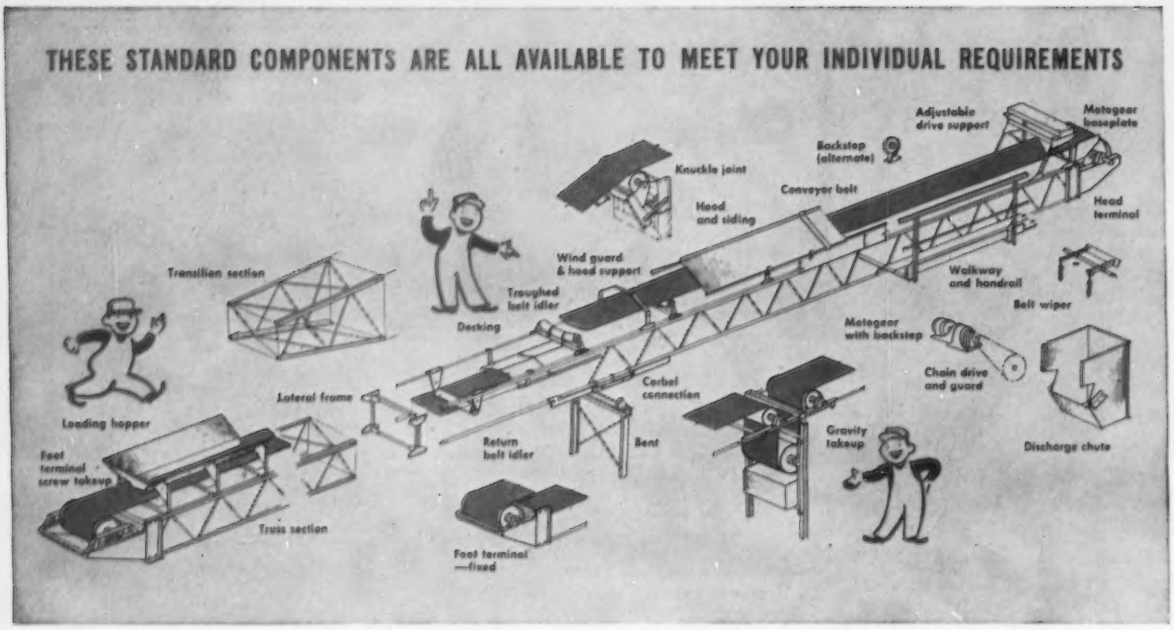

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PRE-BILT PACKAGE

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Book 2579 has further data on Link-Belt PRE-BILT conveyors . . . with drives up to 40 hp and 24 and 42-inch truss depths. Write today, or ask for a copy at your nearest Link-Belt office.

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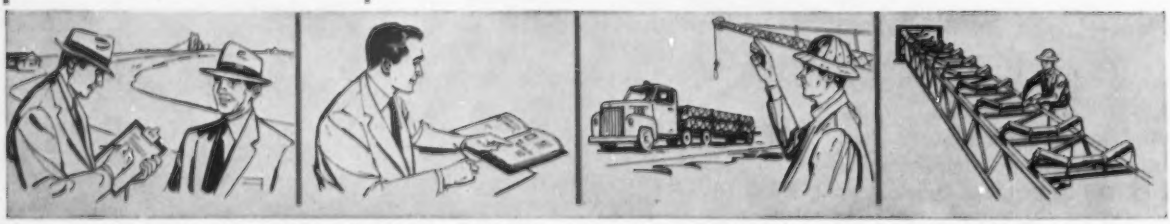
BELT CONVEYOR EQUIPMENT



prompt quotations

He will prepare a comprehensive and accurate estimate of requirements for installations that permit "on-the-ground" survey.

simplified purchase

Parts are standardized, interchangeable, all available from one supplier. Link-Belt representative can furnish all data.

quick delivery

PRE-BILT conveyors are built at nine strategic locations throughout the country and are shipped from the plant nearest you.

fast installation

Can be readily handled by your own erectors in most cases. Link-Belt can also furnish complete erection service and supervision.

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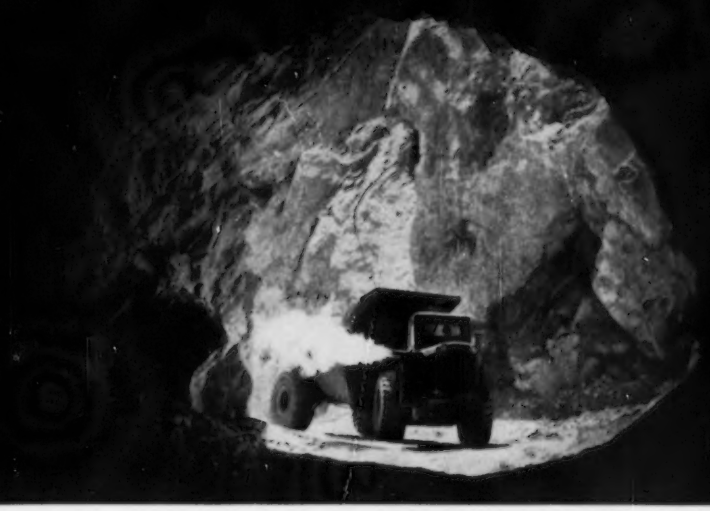

After drilling and blasting operations are finished, "C" Rear-Dump moves in to begin clean-up. Daily, the three machines move 1 "round" or 1000 tons of loose limestone. At this rate, tunnel advances about 12 lineal feet per day. In the confined underground tunnel, "exhaust scrubbers" (shown on this machine) made exhaust gas harmless.

Here's where maneuverability really pays off!

Recently the Riverside Cement Co., Los Angeles, California, began tough tunneling operations in their underground limestone quarry at Crestmore, California. Handling all hauling on this project are 3 C Tournapull Rear-Dumps.

Extremely cramped quarters, adverse grades, long hauls on narrow, winding roads, are major problems testing men and machines every day. However, the rugged "C" Rear-Dumps are doing an outstanding job on this rough assignment. Pictures on this page show how "C's" maneuverability pays off when meeting difficulties like these.

Working in extremely cramped quarters like this, big machines turned in dump position which moves rear wheels forward for extremely short wheel base. "C" in "dump position" (shown in this picture) can turn within 20′ 8″. Its 11′ 4″ height and 11′ width gave ample clearance for the tunneling operation shown here.

Loaded in 6 to 7 passes of 1½-yard Marion shovel, Rear-Dumps averaged 18 tons of limestone per load. 10′4″ overall width-of-bowl gives dipper a big "target", makes loading faster, and easier. Minimum spillage was a major advantage in the tunnel work. These "C's" have 18-ton capacity. The new model "C" has 22-ton capacity.

Floor of this tunnel has 10% adverse grades (7% on curves), making for heavy hauling in close quarters. Torque converters on units automatically balance power to load, make operation easier for operator, cut loss of momentum in shifting, prevent killing engine by inexperienced drivers. They also cut shocks in power train and reduce maintenance.

On the entire 6600′ cycle, units had only 500′ of level haul. The entire route was narrow and winding. Multiple disc air brakes, using 3,763 sq. in. of braking surface, made maneuvering easy... gave operator more confidence on narrow turns. Push button electric controls also contributed to ease of operation and safety.

At a touch of a switch by operator, hoist motor is activated. Body lifts quickly... 18-ton load is dumped easily and fast. Body swings below and behind rear wheels, preventing material from piling under unit. Front wheel drive gives operator control of unit at all times, even when dumping over edge of steep embankment like this.

Tournapull—Trademark Reg. U.S. Pat. Off. R-873-Q-b

LeTourneau-WESTINGHOUSE Company, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

ARBA

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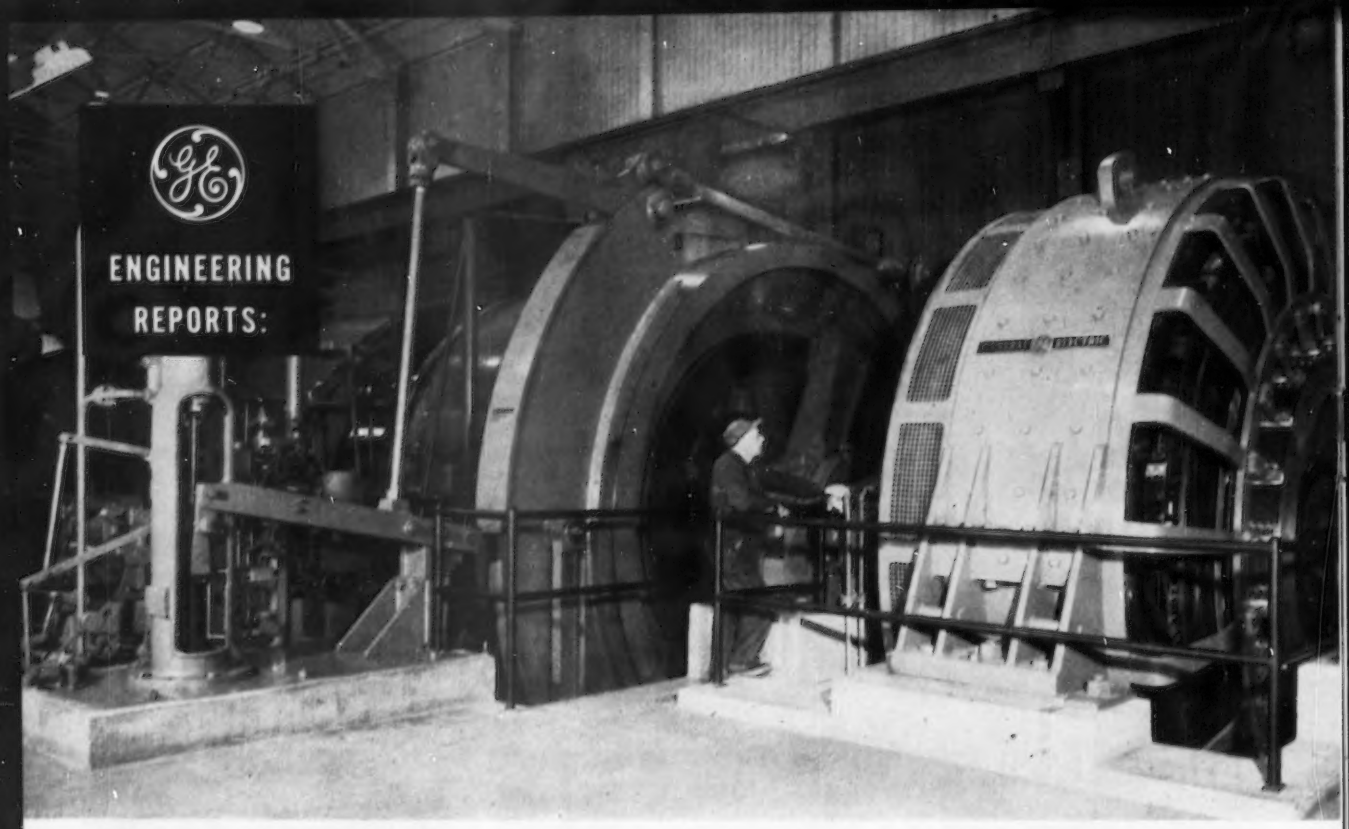


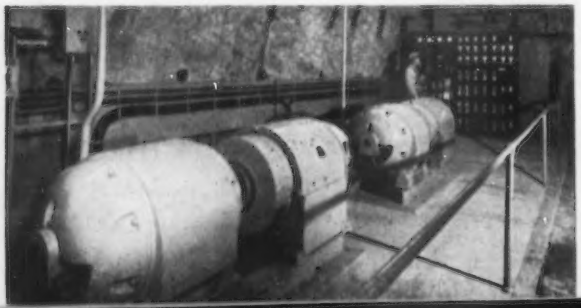
GIANT MINE HOIST at Anaconda's Kelley shaft is driven by 3000-hp General Electric d-c motor, one of world's largest, which was built to Anaconda specifications. Designed for either manual or automatic hoisting, highly reliable drive operates two skips in balance at 2250 feet per minute. Kelley mine output in 1956 averages 15,000 tons of ore per day.

General Electric helps Anaconda maintain

DEPENDABLE General Electric motor-generator set supplies adjustable d-c power to Kelley shaft main hoist drive. It consists of a 2500-kw 600-volt d-c generator driven by 3500-hp synchronous motor and is designed for rugged mine hoist service.

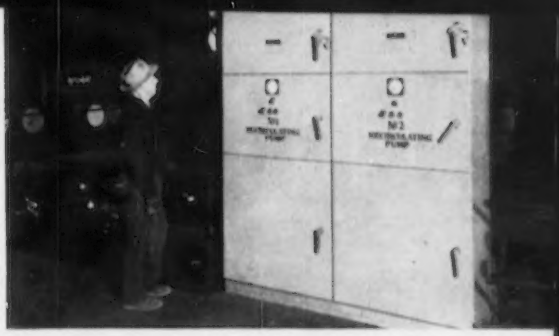
TOUGH MOTOR DUTY is performed by this General Electric 125-hp induction motor in Kelley mine at 600-ft. level. Subjected to abrasive dirt and dust, it effectively drives slusher which drags ore from cave block area and dumps it into chute.

D-C POWER FOR UNDERGROUND HOIST, located at 4000-ft. level of the Mt. Con mine, comes from these General Electric motor-generator sets. The simple, rugged construction of these sets assures day-in, day-out reliability through years of service.



UNDERGROUND HAULAGE SYSTEM at the Anaconda Butte mines includes this electric mine locomotive which was built by General Electric Company. Used to pull ore trains, the locomotive is operated at 4000-ft. level in the Mt. Con mine.

LOW-COST SWITCHING of ore cars at smelter is provided by 65-ton General Electric industrial locomotive. Some G-E locomotives purchased by Anaconda in 1913 have never required a major overhaul.



MINIMUM FLOOR SPACE requirements and extra-fast current limiting action are reasons why new General Electric Limitamp* high-voltage motor control was installed in Anaconda's compressor house.

BETTER MOTOR PROTECTION makes General Electric Tri-Clad* '55' motors, such as these 15-hp standard dripproof induction motors, ideally suited for use in the flotation room at Anaconda concentrator.

*Registered trade-mark of General Electric Company.

HIGH CONVERSION EFFICIENCY is a feature of General Electric mercury arc rectifiers used at Great Falls refinery. In present-day construction live parts are completely enclosed to help protect personnel.

high-tonnage output throughout Butte area

To exploit "richest hill on earth," expanding Anaconda Company has been using General Electric systems, services for 43 years

CENTRALIZED CONTROL of the flotation motors is provided by new, versatile General Electric motor control centers which provide simpler wiring, proper sequencing.

One of the greatest sources of nonferrous mineral wealth in existence is the famous Butte district of the Anaconda Company. In operating, modernizing, and expanding its facilities throughout the area to achieve high-tonnage low-cost output, Anaconda—since 1913—has repeatedly called on General Electric system-engineered equipment and services.

Shown here are typical examples of the power distribution, haulage, and drive equipment supplied over the past 43 years, in operations ranging from mining to refining, that have helped make Anaconda a satisfied General Electric customer.

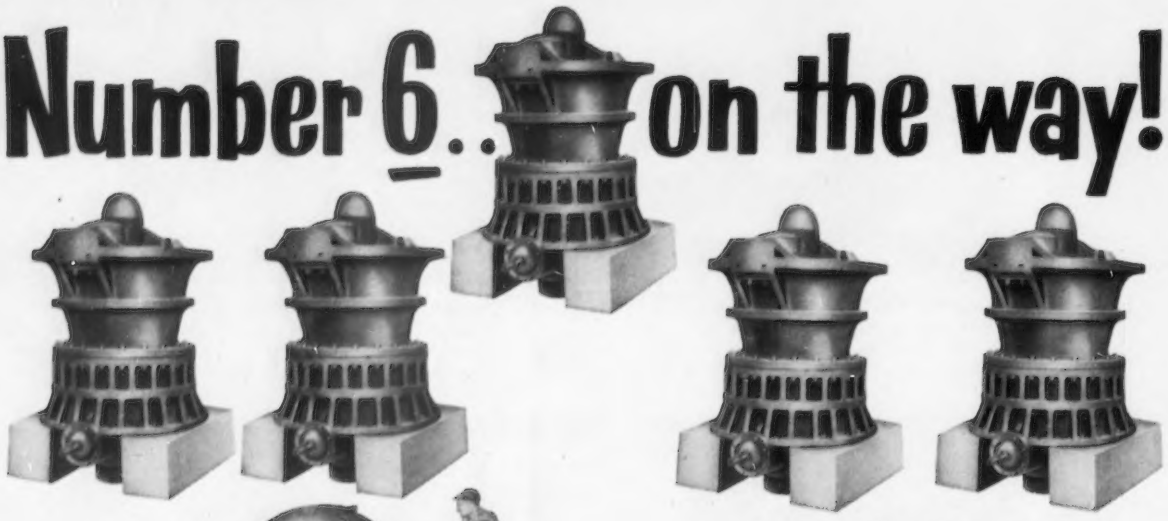
Close co-operation among Anaconda, consulting, and General Electric engineers expedited the design of electrical systems, co-ordination of deliveries, installation and start-up of the Butte district's new facilities during the 43-year period.

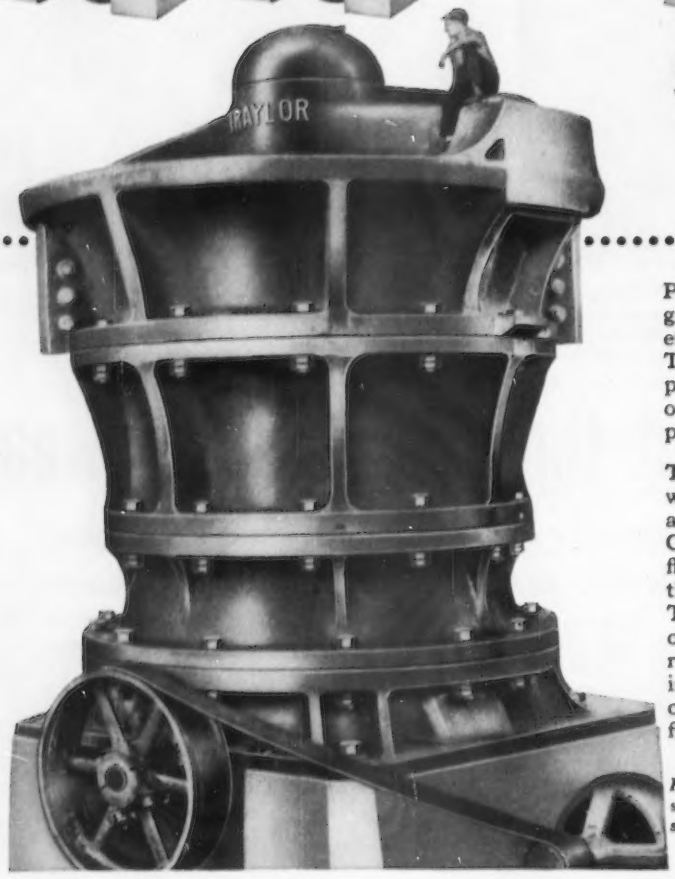
The same General Electric engineering and equipment leadership is available to you in your expansion or modernization plans—ready to help you increase mining output, reduce costs with an electrical system to meet your individual needs. For more information, contact your nearest General Electric Apparatus Sales Representative. General Electric Company, Schenectady 5, N. Y. 660-35

Engineered Electrical Systems for the Mining Industry

GENERAL ELECTRIC

Number 6... on the way!





Another Traylor TC Gyratory is added to the 5 on order for Big Taconite Project

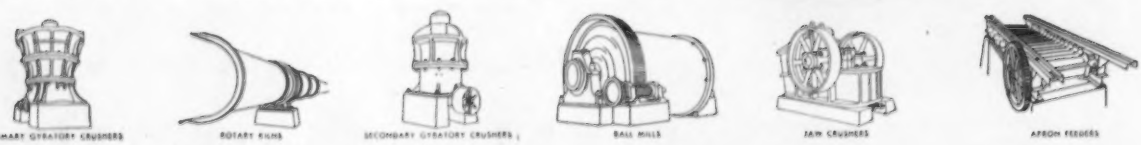
Profitable production of iron ore from low-grade Taconite calls for the most modern, efficient methods and equipment. That's why Traylor Gyratories were the choice for both primary *and* secondary reduction at one of the extremely hard Taconite-bearing ore properties.

The initial order included a Gyratory Crusher with 60″ receiving opening and 102″ diameter crushing head, this huge TC Primary Crusher takes chunks of ore the size of a flat-top desk and reduces them to 12″ at the rate of 4,000 long tons an hour. Four Traylor 36″ Gyratories were included on the original order . . . to take the 12″ ore and reduce it to minus 5″ in the secondary crushing operation. Now . . . we've received an order for another 36″ Gyratory to join the five now being built.

For complete specifications and description of the outstanding features of Traylor TC Gyratory Crushers, send for your copy of Traylor Bulletin #126.

TRAYLOR ENGINEERING & MFG. CO.
857 MILL ST., ALLENTOWN, PA.
SALES OFFICES: New York · Chicago · San Francisco
CANADIAN MFRS: Canadian Vickers, Ltd., Montreal, P.Q.

Traylor



delivered...by THERMOID

This Thermoid conveyor belt is handling bauxite at an unloading dock in Baton Rouge, La. It was selected for maximum flexibility and resistance to loading impact.

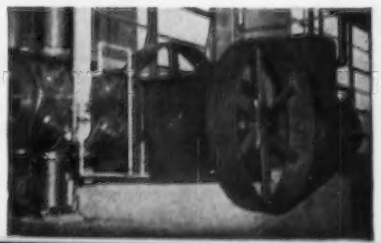
Whatever your materials handling job, there are Thermoid conveyor belts designed to meet your requirements. For example: Thermoid HT for extremely abrasive materials such as quartz ores, trap rock and coal . . . Thermoid A for highly abrasive materials: slag, lime rock, ore, ashes, hot cement and crushed stone . . . Thermoid C for moderate abrasives such as sand, loam and gravel.

Put belts like these to work on your conveyors. Get the long wearing advantages of Thermoid's exclusive impregnation process. It welds belt carcass and cover into a real brute for punishment! Thermoid's specially woven, finest quality reinforcement troughs easily—withstands shock loading like no ordinary belt can do.

Your Thermoid Distributor will be glad to help you select the conveyor belt that's right for your needs.

Thermoid makes many types of hose designed for specific mining applications. Quality construction saves hose dollars.

Maximum efficiency in power transmission is assured with long wearing matched sets of Thermoid Multi-V Belts.



Thermoid

THERMOID COMPANY, Trenton, N.J.

WE WANT YOUR TOUGH JOBS!

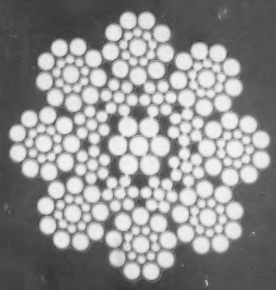
for J&L CenterFit Wire Rope

Three characteristics give J&L CenterFit Wire Rope the staying power to develop outstanding service in applications where shock, fatigue, and heavy loading limit the service life of standard wire rope.

1. CENTERFIT is the strongest standard rope produced.
2. CENTERFIT is more flexible in operation than any standard IWRC rope.
3. CENTERFIT has unsurpassed resistance to shock loading.

Over the years CenterFit has built a record for outstanding service life on the toughest applications such as shovel hoist ropes, back hoe pull ropes, and clamshell holding and closing lines where overloading is a factor.

If you're operating where loading, shock and fatigue are severe, chances are J&L CenterFit can help you cut your wire rope costs. Contact your nearest J&L Office or representative.



Jones & Laughlin
STEEL CORPORATION · PITTSBURGH

You Get "Pay-Off" Performance Every Day with Le Roi-Cleveland Sinkers

... because they have the right force of blow and strong rotation, from proper valve design and port arrangement

That's why Le Roi-Cleveland Sinkers bite into more rock . . . drill more footage per shift. A fast, postive-action end-seating valve, and precise port arrangement, provide powerful force of blow and strong rotation. And this automatic valve meters the air, too. It keeps air consumption down. You get longer life because the performance of this valve is not affected by wear.

Le Roi-Cleveland Sinkers are lubrication-protected. The rifle bar is oiled at every stroke of the piston. This prolongs rifle nut life by 50 per cent or more. That's one of the reasons why you get "pay-off" performance every day in all conditions. Le Roi-Cleveland Sinkers are at their best when the going is toughest.

There's plenty of hole-cleaning power to aid the powerful force of blow and strong rotation of Le Roi-Cleveland Sinkers. They take a fresh bite of rock with every piston blow.

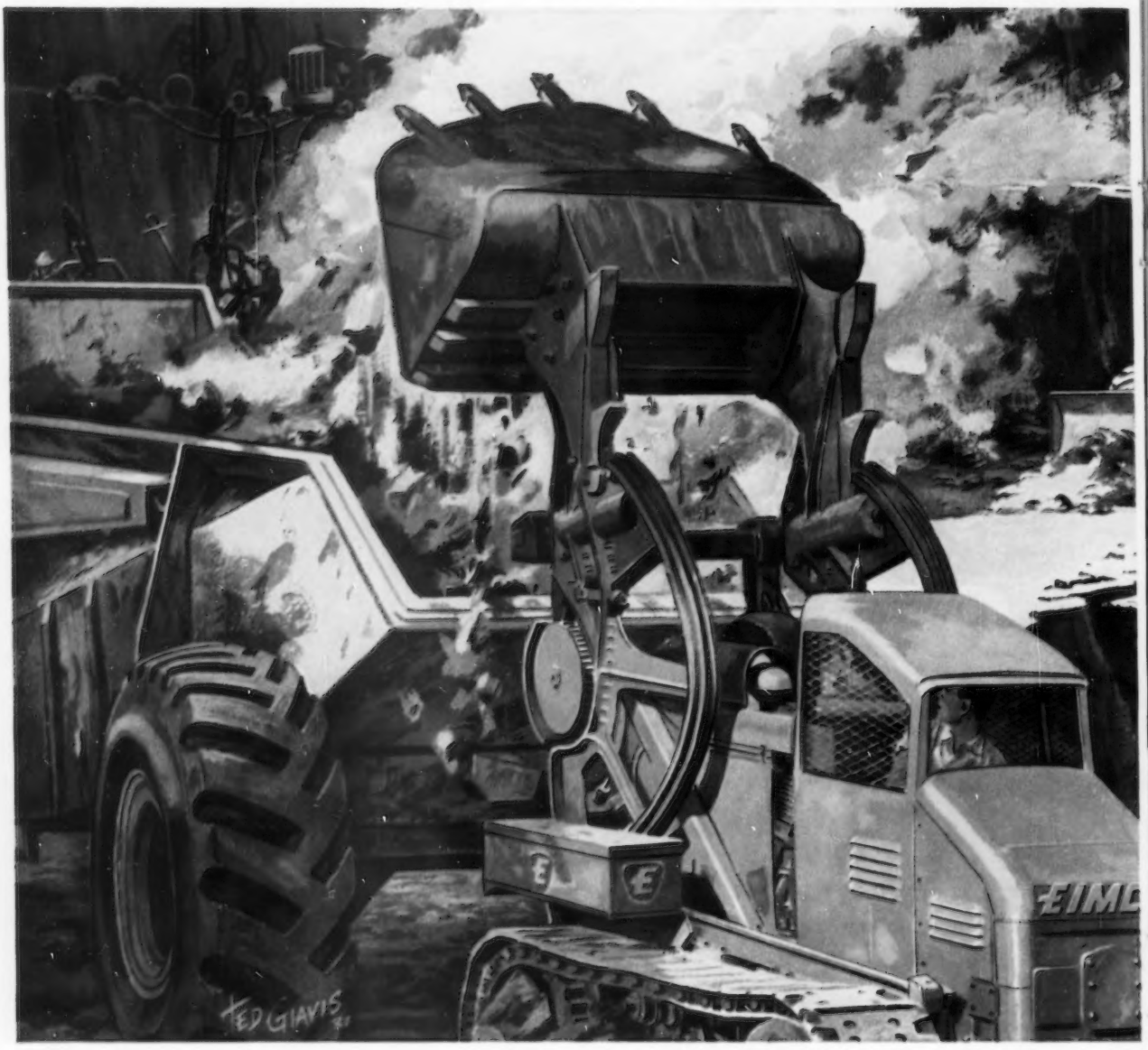
"Pay-Off" performance is really built into all Le Roi-Cleveland Sinkers. Use them to get peak efficiency every day . . . drill more feet of hole per shift. A complete line of Le Roi-Cleveland Sinkers is available from 18 to 80 lbs. Write today for full information.

RD-77

LE ROI *Division of Westinghouse Air Brake Co.*

Milwaukee Wisconsin

What is the best



It's GM . . . America's First Choice Diesel . . . and here's why:

Best Diesel for mining—or any other job, for that matter—is the one that does the most work at the lowest cost, above or below ground.

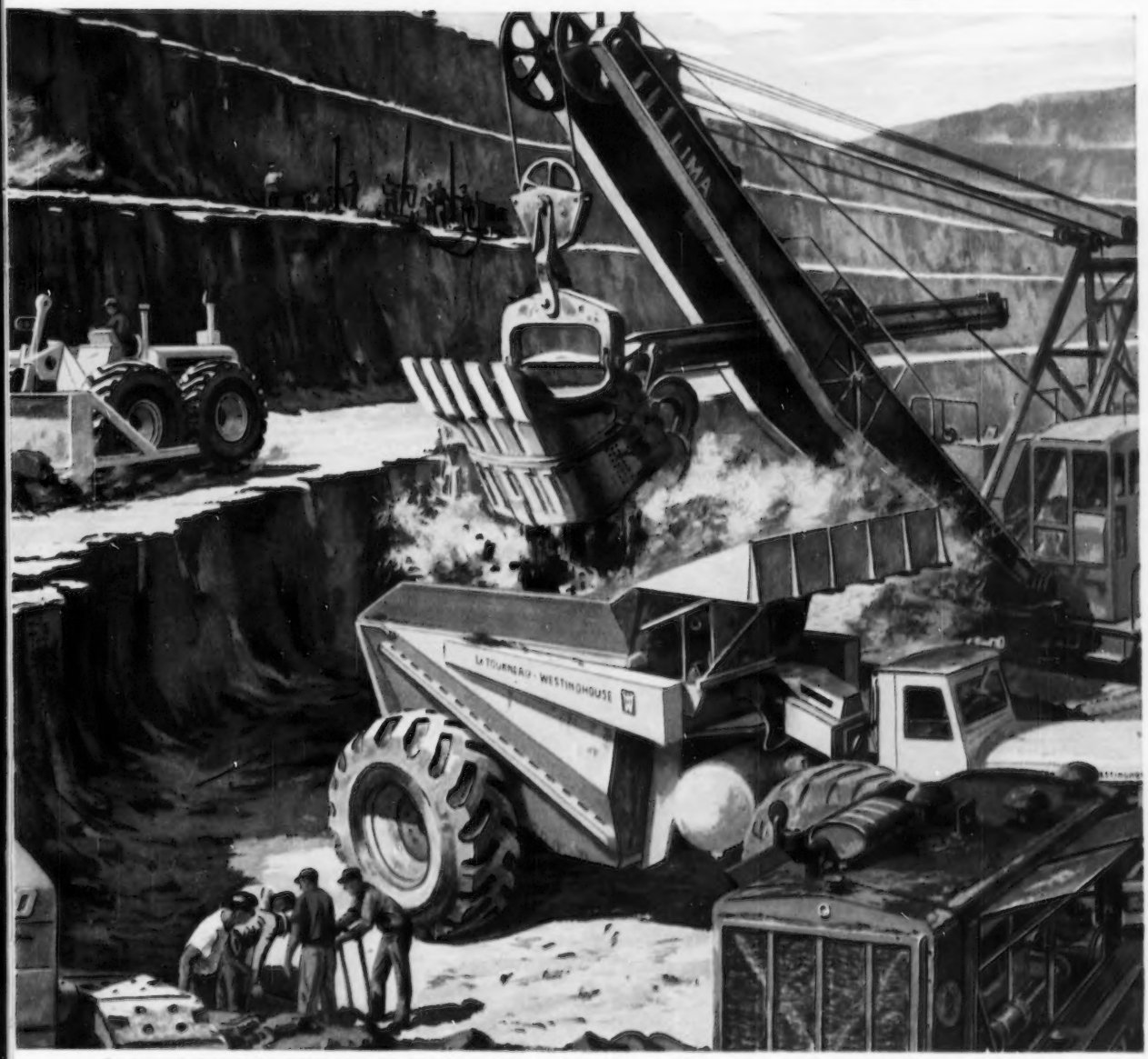
That's why General Motors Detroit Diesel engines today handle more different mining jobs than any other Diesel.

These compact, clean-running 2-cycle engines drive loaders, air compressors, draglines, locomotives, pumps, shovels and the most powerful trucks and tractors. GM Diesels are available in more than 1000 different applications of power machinery for every job from 30 H.P. up.

And with the recent addition of Turbopower engines to the line, increased horsepower with greater efficiency is now available in the same size engine. These new Turbopower Diesels develop up to 17% more power on no more fuel —or the same power with a 15% saving in fuel.

Next time you order new equipment—or repower old—be sure to specify GM Diesel. It's America's FIRST CHOICE Diesel *because it does more work at less cost!*

Diesel for Mining?



Equipment shown above includes: Elmco tractor-loader; LeTourneau-Westinghouse Tournatractor and Rear Dump; Lima Paymaster shovel; Gardner-Denver air compressors. Write for list of over 1000 GM Detroit Diesel power applications.

GM
GENERAL MOTORS
DIESEL POWER

DETROIT DIESEL

Engine Division of General Motors

Detroit 28, Michigan
In Canada: General Motors Diesel Limited, London, Ontario

Single Engines . . . 30 to 300 H.P. *Multiple Units . . . Up to 893 H.P.*

America's Largest Builder of Diesel Engines

Why a yielding arch is superior to rigid roof support

In moving ground, no rigid support, however big or of whatever material, can indefinitely withstand the dynamic pressures caused by the weight and subsidence of overburden. In fact, the more rigid the support the more it may aggravate the condition. That's because a rigid support does not distribute the loads uniformly, thus preventing a pressure zone from forming around the mine opening.

But an arch that will yield, such as the Bethlehem Yieldable Arch, allows the overburden to settle slowly forming its own natural arch, which in turn carries the major portion of the load. As the Bethlehem Arch yields, the stress is absorbed by the rock itself until equilibrium is reached.

Thus it is not the strength alone but the "give" of the Yieldable Arch that holds a tunnel or drift open. This yieldable feature comes from nesting the segments of an arch set one into the other so that they overlap. The U-bolt clamps that hold the overlapping segments together are drawn tight enough to create the right amount of friction. When the load becomes excessive it overcomes the friction sufficiently to make the segments slide, equalizing the pressure.

Each arch set is tied to its neighbor by horizontal steel struts attached with J-bolts to maintain proper spacing and lateral stability. Two spacer lugs are welded to the flanges at each joint to keep the U-clamps correctly spaced and provide more uniform frictional resistance. A Bethlehem engineer will be glad to consult with you on the application of Yieldable Arches to your mine. You can reach him through any Bethlehem sales office.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation.
Export Distributor: Bethlehem Steel Export Corporation.

BETHLEHEM STEEL

BETHLEHEM STEEL

HERE'S 3-WAY PROTECTION AGAINST PRODUCTION LOSSES

You can't buy better Insurance against "downtime losses" caused by faulted power feeders and lighting lines . . . than JOY electrical connectors, portable lighting lines (String-a-lite) and cable vulcanizers provide. Designed by an organization which has been making this type equipment for Metal Mining needs for almost thirty years, these JOY products can be relied on to provide years of dependable, maintenance-free service.

Yours for the asking WITHOUT OBLIGATION

BULLETIN B56 & B57
Provide complete information on JOY Attachable and Molded-to-cable type connectors.

ELECTRICAL PLUGS AND RECEPTACLES . . . More JOY electrical connectors are used in mining operations than all other brands combined. Factory molded as resilient Neoprene/rubber insulated units, they can't crack or lose shape when struck hard blows . . . are moisture and dust tight . . . and require no pampering to provide a long life of safe, efficient service. Hundreds of styles and sizes are available for mining needs. So for production's sake, remember JOY when you need electrical connectors . . . Bulletin No. B56 provides details. Ask for your copy.

BULLETIN No. B52
Twelve pages of illustrations and descriptions on JOY portable lighting (String-a-lite) and tool-outlet strings.

PORTABLE LIGHTING LINES (String-a-lite) . . . Require no special tools or talents to install or dismantle. Can be quickly lengthened, shortened or moved to meet the exact needs of any working or passage area. Supplied in one-piece factory molded sections of 2 to 10 light outlets that inter-connect through JOY male and female "end-plugs" to make up the complete string. Choice of five socket and two end plug designs. Mating power receptacles also available. Bulletin B52 provides complete details.

BULLETIN No. B48a
Describes and illustrates JOY's complete line of cable vulcanizers, molds and vulcanizing supplies.

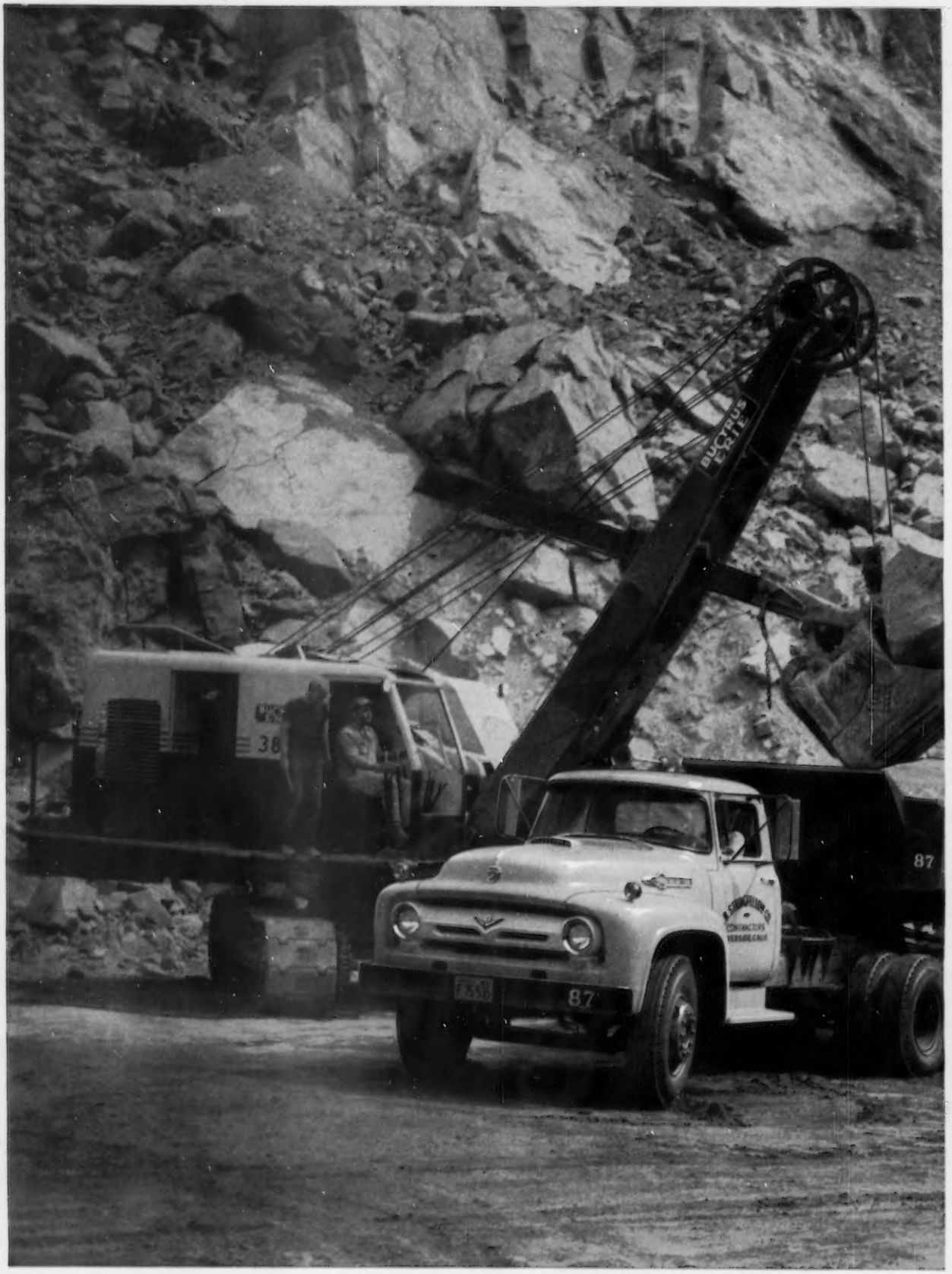
CABLE VULCANIZERS . . . for rubber, Neoprene, Buna S and thermoplastic jacketed cables. Simple in operation, JOY vulcanizers quickly pay for themselves by making it possible to repair cuts and breaks in vital portable power lines immediately. Two types are available — "Steam" and "Direct Heat." Both are heated electrically with automatic temperature controls. Bulletin B48a describes these vulcanizers in detail and lists molds vs. cable sizes. Ask us for your free copy.

Consult a Joy Engineer

JOY MANUFACTURING COMPANY
General Offices: Oliver Building Pittsburgh 22, Penna.
In Canada: Joy Manufacturing Co., (Canada) Ltd., Galt, Ont.

JOY
Specialists in Creating Electrical Connectors for Mining Applications, Since 1928

CD 356.3


BUCYRUS ERIE
87
87

says Mr. J. B. Stringfellow, J. B. Stringfellow Co., Riverside, Calif.

"Our 17 Fords all deliver Pay Rock"

J. B. Stringfellow Co.'s Ford T-800's average 19 tons a load. "And each of our four F-800's have over 200,000 miles on them and still carry 13 tons with ease."

"Rip Rap and Derrick Stone are our business," says Mr. Stringfellow. "And for 18 years Ford trucks have made these big rocks pay for us. We've even carried a 21-ton rock in our Fords. Some truck—that Ford."

Payload means a lot in any operation. And the Ford T-800 is just one of the Ford line with an eye for better payloads. The T-800 gross combination weight is up to 65,000 lb. capacity.

Ford trucks prove they can "take it" under the roughest conditions. That's why Ford trucks last longer.

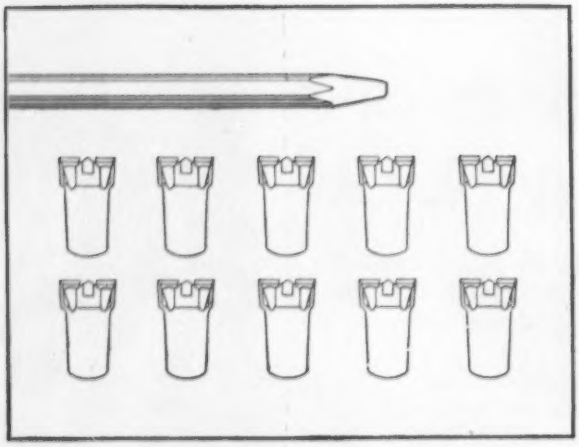
Look at the '56 T-800's power plant! Your choice of the 200-hp Torque King, or the 212-hp Torque King Special—the most powerful engine ever offered in a Ford truck. Power Steering is standard on these BIG JOBS.

So consider everything, when you go to buy that new truck—initial price, running costs, dependable performance, and resale value. Check your Ford Dealer and find out why Ford trucks cost less.

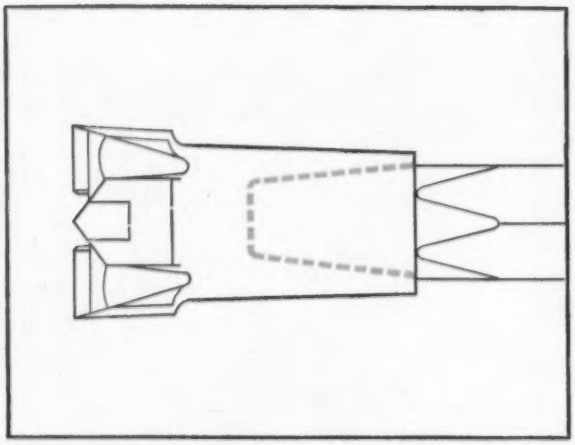
FORD TRUCKS COST LESS!

New Timken® tapered

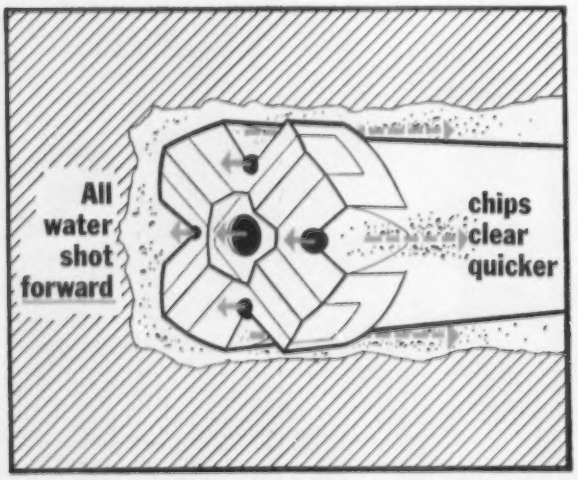
It's removable, remains secure, speeds chip



1 CHANGE BITS—SAVE STEEL. Simply remove the old bit, put the new one on the same drill steel. You don't have to lug heavy steels back to the shop for re-sharpening. And no need to throw away the steel when the bit is used up. You can drill out the full life of every steel . . . cut steel costs.



2 TAPERED SOCKET STAYS TIGHT. The new Timken® bit has a tapered socket that provides a more secure union than threads for air-leg drills. Its precision-made taper fits tight to the drill steel, reduces breakage, cuts expense. Gives you lowest cost per foot-of-hole.

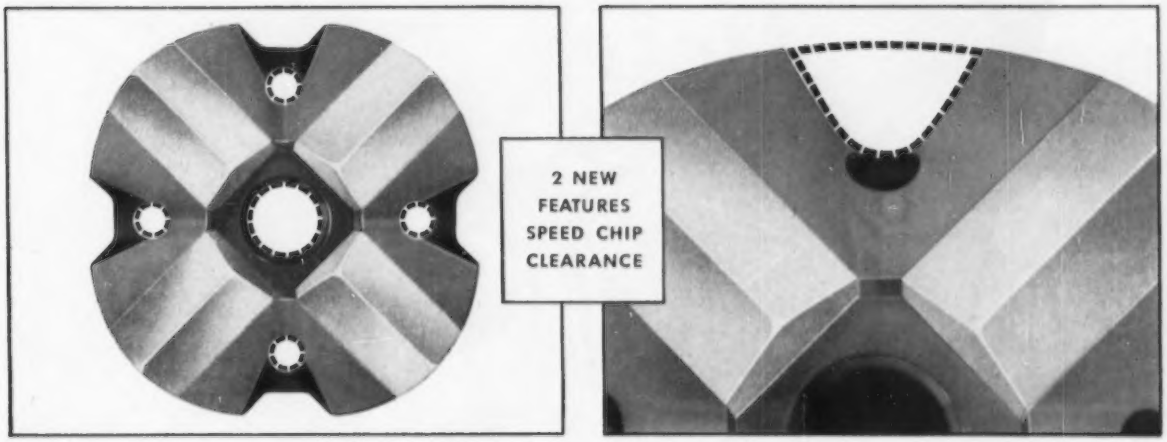


5 HOW CHIPS CLEAR FASTER. Here's how five front holes and the deeper, wider clearance, working together, clear chips faster—speed drilling—lengthen bit life. New, special analysis carbide inserts give cutting face superior wear resistance. Write today for free brochure. The Timken Roller Bearing Company, Canton 6, Ohio. Cable: "TIMROSCO".

NEW TIMKEN THREADED BIT FOR OTHER TOUGH DRILLING JOBS. These new design features speed chip removal. 1) five front holes; 2) deeper, wider clearance; 3) deeper undercut under the heel. New wear-resistant carbides add life. Improved thread contact reduces breakage. You get lower cost per foot-of-hole.

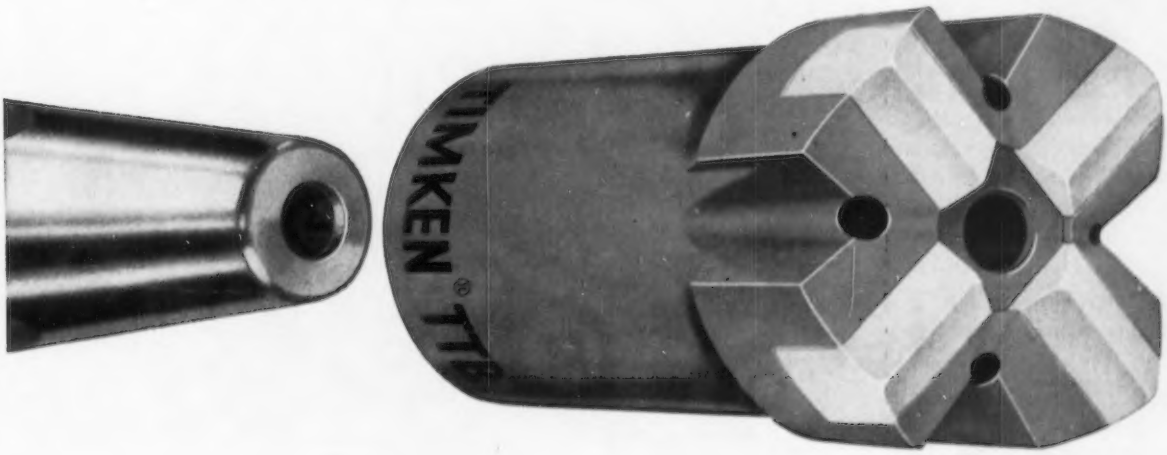
socket bit FOR AIR-LEG DRILLS AND LIGHT STOPING

removal—gives lower cost per foot-of-hole



3 FIVE FRONT HOLES. New frontal design has five front holes that shoot the water streams directly in front of the bit—wash away chips faster. Bit spends more time drilling new rock, less time "drilling" chips. Larger center hole, with plug dropped deeper for freer cutting action, means less drag on the bit.

4 DEEPER, WIDER CLEARANCE. Extra deep, wider clearance between cutting wings permits water to carry chips faster from the cutting face of the bit. This faster chip flow speeds drilling and helps increase cutting efficiency. See diagram at left, below.



TIMKEN REMOVABLE ROCK BITS

TRADE-MARK REG. U. S. PAT. OFF.

Your best bet for the best bit for every job...threaded carbide insert, multi-use, tapered carbide insert

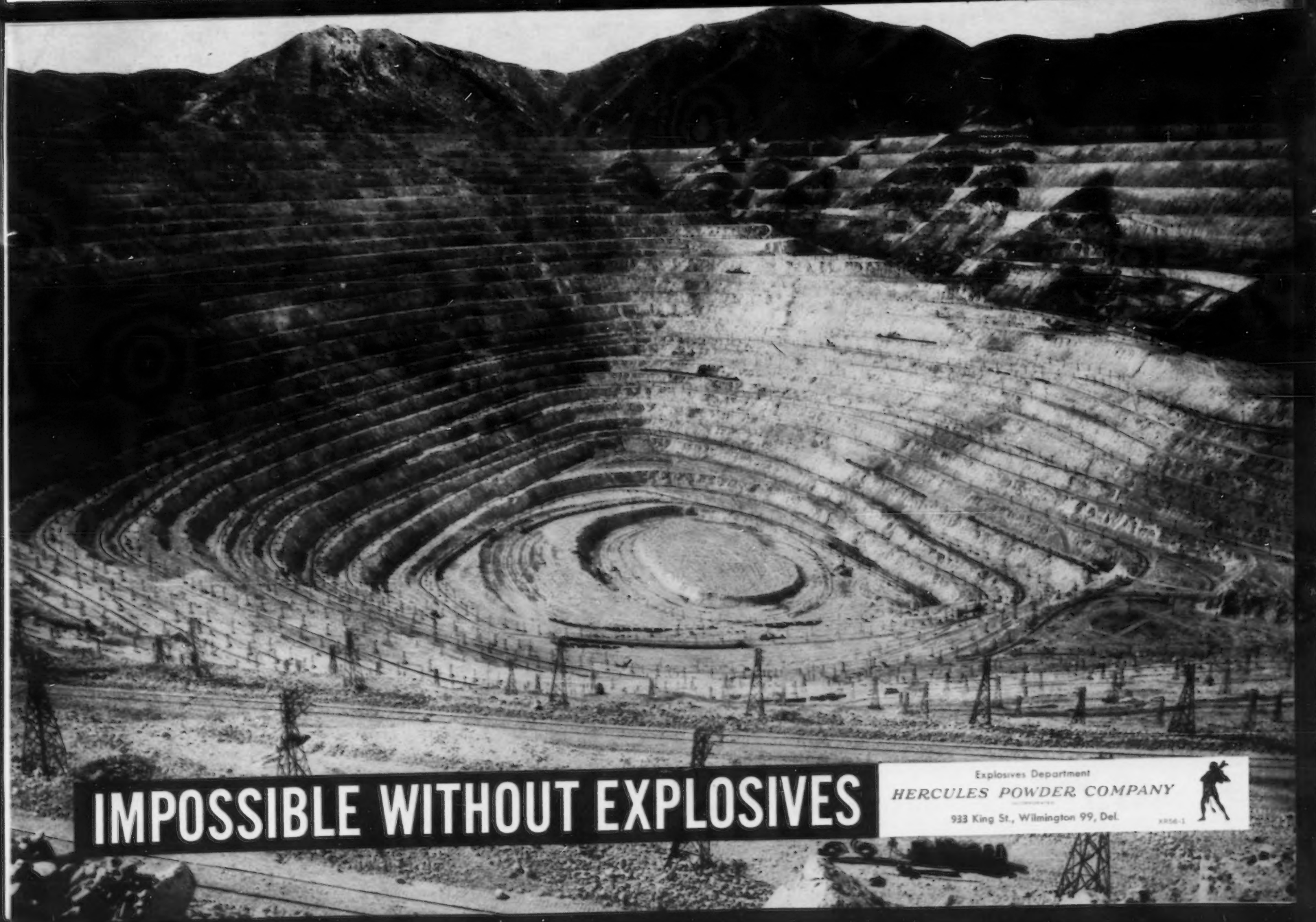
TOUGH HEAVY DUTY MINING CABLES *that have no equal!*

New SUPERTUF JACKET* makes SUPER SERVICE MINING CABLES *tougher than tough*

***General Cable's remarkable Flame Resistant SUPERTUF JACKET is a new neoprene compound processed for maximum lasting toughness, high density and tensile strength—*extra smooth* for wear, cut and tear resistance.**

General Cable... *at your service!*

GENERAL CABLE CORPORATION, 420 Lexington Avenue, New York 17, N.Y. Offices and Distribution Centers Coast-to-Coast

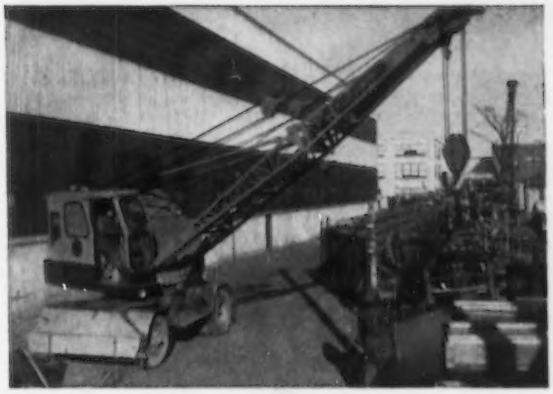

IMPOSSIBLE WITHOUT EXPLOSIVES
Explosives Department
HERCULES POWDER COMPANY
933 King St., Wilmington 99, Del.
XR56-1

KOEHRING WORK CAPACITY *in action . . .*

Quarry rock — Take another look at the heavy-duty shovel (above), loading rock at a Midwest quarry. It's the new Koehring ¾-yard 305, with 18-foot deep-section boom, and 15-foot dual dipper-sticks. In heavy digging like this, operators like the light lever-pull of its big power clutch, and accurate "feel" of load. *You'll* like its *extra work capacity* with all attachments, on crawlers or rubber (see ratings on next page).

Mining phosphate — After stripping overburden at a Southern mine (right), 605 dragline loaded phosphate out of the deep cut. It has plenty of work radius for this type of operation — can be used with 50 to 110 feet of boom, and handles 1½ to 2½ cu. yd. dragline or clamshell buckets, depending on weight of materials. Better check what this big Koehring 605 can do on your excavating, lifting and material-handling.

21.5 m.p.h. Cruiser® — One man controls all operations, one engine supplies all power for work and travel on the new Koehring 205 Cruiser Crane. There's a full range of low working speeds to 7 m.p.h. — plus travel speeds up to 21.5 m.p.h. Has smooth torque-converter drive, power-steering, climbs 30% grades. Usefulness is unlimited in mines, pits and quarries. It lifts up to 15 tons — handles ½ to ¾-yard clamshell or dragline buckets — converts to shovel or hoe. Versatile Koehring 205 also is available on truck mounting or on heavy-duty crawlers (more details below).

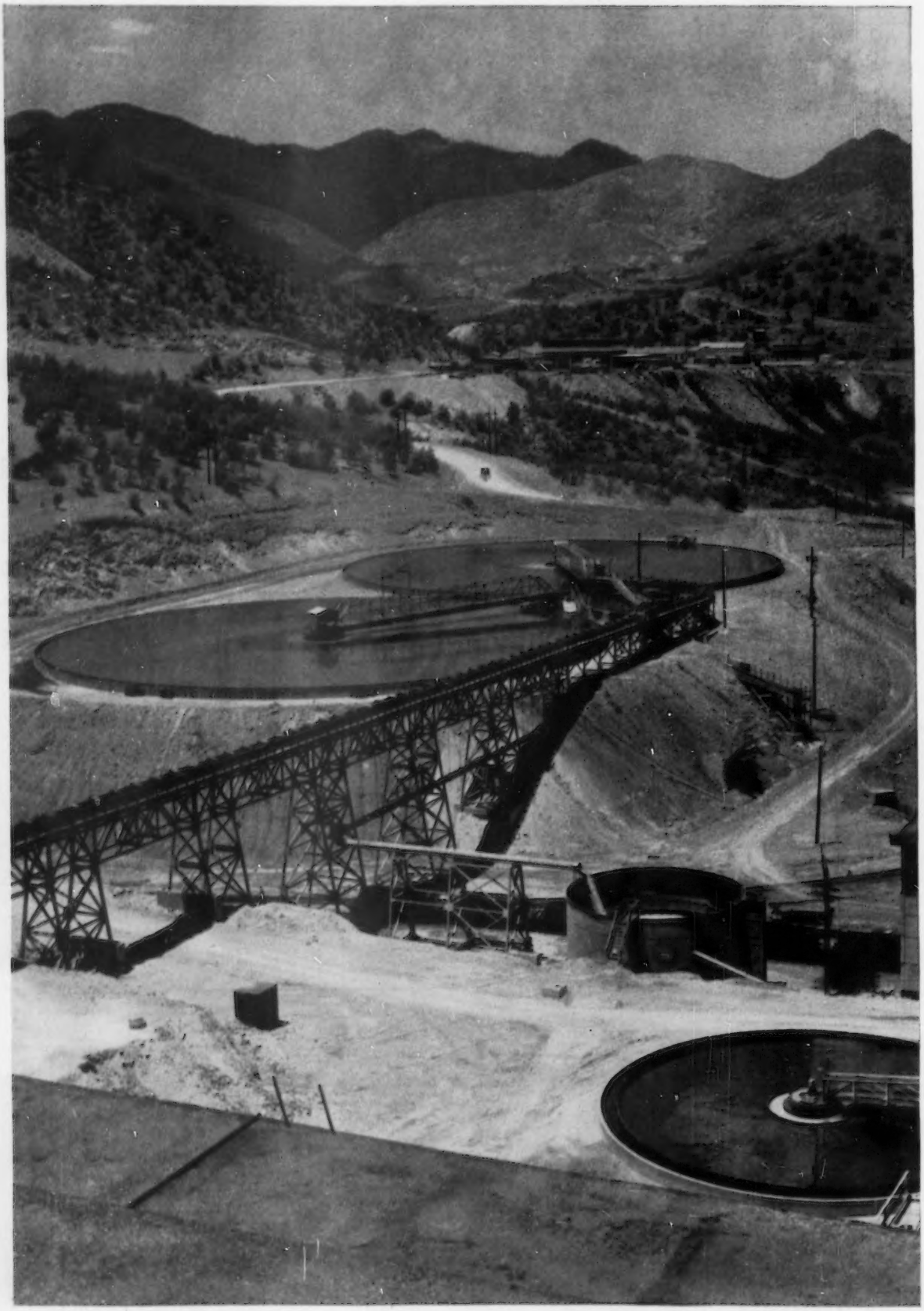


Stockpile specialist — Owner of this yard put stockpiling on a big-tonnage basis with a 405 clamshell crane. Its smooth swing, fast line speeds, and wide work radius pay off on all kinds of material-handling. This 405 is another in the modern, new series of Koehring excavators and cranes. Want more information? Call your Koehring distributor today.

Here are some figures that will interest you:

KOEHRING MODEL	SIZE DIPPER	LIFT CAPACITIES (Crawler ratings based on 75% of tipping load. Rubber-tired machines — 85% of tipping load.)	
205 CRAWLER	½-Yd.	20,000 lbs.	at 10-foot radius
205 ON RUBBER	½-Yd.	30,000 lbs. 13,700 lbs.	at 12-foot radius at 20-foot radius
305 CRAWLER	¾-Yd.	30,000 lbs.	at 12-foot radius
305 ON RUBBER	¾-Yd.	50,000 lbs. 15,800 lbs.	at 10-foot radius at 30-foot radius
405 CRAWLER	1-Yd.	40,000 lbs.	at 12-foot radius
605 CRAWLER	1½-Yds.	72,300 lbs.	at 12-foot radius
1205 CRAWLER	3-Yds.	190,000 lbs.	at 13-foot radius

KOEHRING COMPANY Milwaukee 16, Wis. Subsidiaries: JOHNSON PARSONS • KWIK-MIX



DOW

. . . in these settling tanks

Separan 2610 increased mill tonnage 1600 tons a day

Another production record set with the new high-speed flocculant Separan 2610

Here's the report:

Before using Separan 2610® as a settling aid in the thickening of flotation tailings, this copper processor had to reduce mill tonnage due to insufficient water. Now, that's ended.

The settling speed of Separan 2610 has brought a remarkable increase in water recovery. Slow-ups and overloading are eliminated. Average density of underflow has been raised from 43% solids to over 53%, with density running as high as 60% solids! Result: Production is up 1600 tons a day, and only .0041 lb. of Separan 2610 is required per ton of solids in the tailings!

Fast and easy to use

In the opinion of this mill's director, Separan 2610 is the most important mining chemical discovery in many years. Similar praise is being echoed throughout the mining industry.

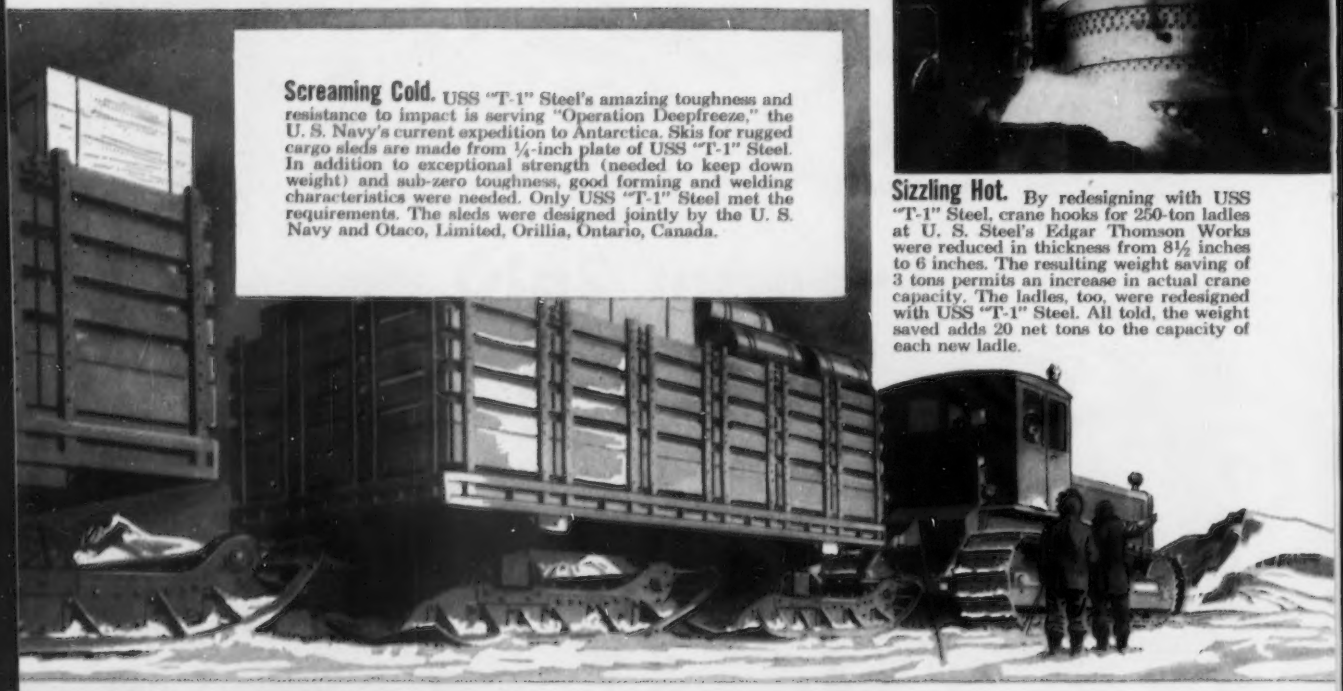
For, in addition to its high speed, Separan 2610 is easy to prepare and apply . . . has proved itself with a wide variety of materials. Stock solutions require no heat or preservatives. What's more, this synthetic organic polymer is effective in both acid and alkaline circuits; presents no hazard in normal use; and adds no excess bulk. Truly, a revolutionary product worth investigating!

We will gladly send a sample for your evaluation, and lend technical assistance to assure you the full high-speed advantages of Separan 2610. Write us, describing your process application. THE DOW CHEMICAL COMPANY, Technical Service and Development, Dept. SC 928B, Midland, Michigan.

Also available are samples of other Dow mining chemicals that have become famous for efficiency. In floating sulfides, Dow Xanthates are first choice for their wide range of selectivity, and Dowfroth® 250 for its livelier froth and low consumption rate.

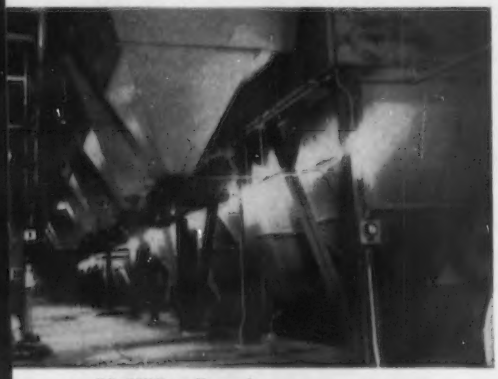
you can depend on DOW CHEMICALS DOW

HOW USS "T-1" STEEL IMPROVES THESE PRODUCTS:



Screaming Cold. USS "T-1" Steel's amazing toughness and resistance to impact is serving "Operation Deepfreeze," the U. S. Navy's current expedition to Antarctica. Skis for rugged cargo sleds are made from ¼-inch plate of USS "T-1" Steel. In addition to exceptional strength (needed to keep down weight) and sub-zero toughness, good forming and welding characteristics were needed. Only USS "T-1" Steel met the requirements. The sleds were designed jointly by the U. S. Navy and Otaco, Limited, Orillia, Ontario, Canada.

Sizzling Hot. By redesigning with USS "T-1" Steel, crane hooks for 250-ton ladles at U. S. Steel's Edgar Thomson Works were reduced in thickness from 8½ inches to 6 inches. The resulting weight saving of 3 tons permits an increase in actual crane capacity. The ladles, too, were redesigned with USS "T-1" Steel. All told, the weight saved adds 20 net tons to the capacity of each new ladle.



28 Million Pounds of wet, abrasive coal are handled each day at this steam-electric generating station. And USS "T-1" Steel is being used at points of severe wear in coal chutes and hoppers, pulverizer feed pipes and exhaust pipes, and for liners of ash collectors. USS "T-1" Steel's durability under impact and impact abrasion, its great tensile strength and its good weldability are often essential in rugged coal handling equipment. USS "T-1" Steel can add service life and cut repair and maintenance costs in many types of heavy-duty equipment.

Repair Reduces Downtime. In this coal stripping operation, time costs more than any other item; and *lost* time, caused by breakage and wear of power shovel parts, was costing far too much. So the owner, Putnam & Greene, Inc., Philipsburg, Pennsylvania, started using USS "T-1" Steel for repair work. As a result, size and weight of parts have been reduced, while durability has been improved substantially. What's more, USS "T-1" Steel's good weldability speeds repair work.

How It Can Help You

USS "T-1" Steel, with its high minimum yield strength of 90,000 psi and its minimum tensile strength of 105,000 psi, can help you design or build lighter-weight equipment that will last longer. Its unusual toughness can help you design or build equipment capable of taking heavy impact and abuse at sub-zero temperatures. Its excellent weldability can help you cut the cost of fabricating highly stressed parts, and to reduce repair and maintenance expense. Its good creep rupture strength can help you put more durability in equipment that operates at temperatures as high as 900 degrees F.

Somewhere in your operation, versatile USS "T-1" Steel can help you. Write, wire, or phone United States Steel, Room 5440, Pittsburgh 30, Pa.

UNITED STATES STEEL CORPORATION, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO • TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS, COAST-TO-COAST • UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS "T1" CONSTRUCTIONAL ALLOY STEEL

USS

UNITED STATES STEEL

an ACCO product

American Cable TRU-LAY VHS | 15% STRONGER

New VHS Dragline Lasts 73% Longer

Draglines on the excavator above, used in coal stripping operations at the Kingston Mining Company, Plymouth, Pa., get really rough service. The best Improved Plow Steel lines formerly lasted only 700 hours.

Now, however, lines of new TRU-LAY VHS are averaging 1,250 hours —giving 73% longer service life.

Records like these are being duplicated by VHS Draglines all over the country. For new VHS is tougher—more wear resistant. And it has all the advantages of preformed construction.

Your American Cable Distributor has TRU-LAY VHS *in stock now. See him or write to the nearest American Chain & Cable Company Office.*

STRONGER AND SAFER

New VHS is 15% stronger than Improved Plow Steel, which was the strongest available until now. Its additional strength enables you to handle heavier loads with the same diameter line. And it gives you a higher factor of safety during the entire service life of the rope.

FOR SHOVEL HOIST ROPES AND SLUSHER ROPES, TOO

TRU-LAY VHS was developed particularly for the toughest applications in the mining industry — draglines, shovel hoist ropes and slusher ropes. It stands up better under the rough treatment these ropes necessarily get.

LESS "DOWN TIME"—CUTS COSTS

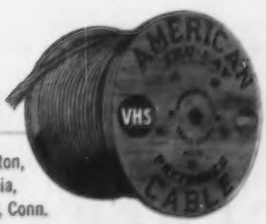
Because it is tougher and more wear resistant, TRU-LAY VHS rope lasts longer, costs less to use and cuts "down time" of equipment for wire rope replacement.

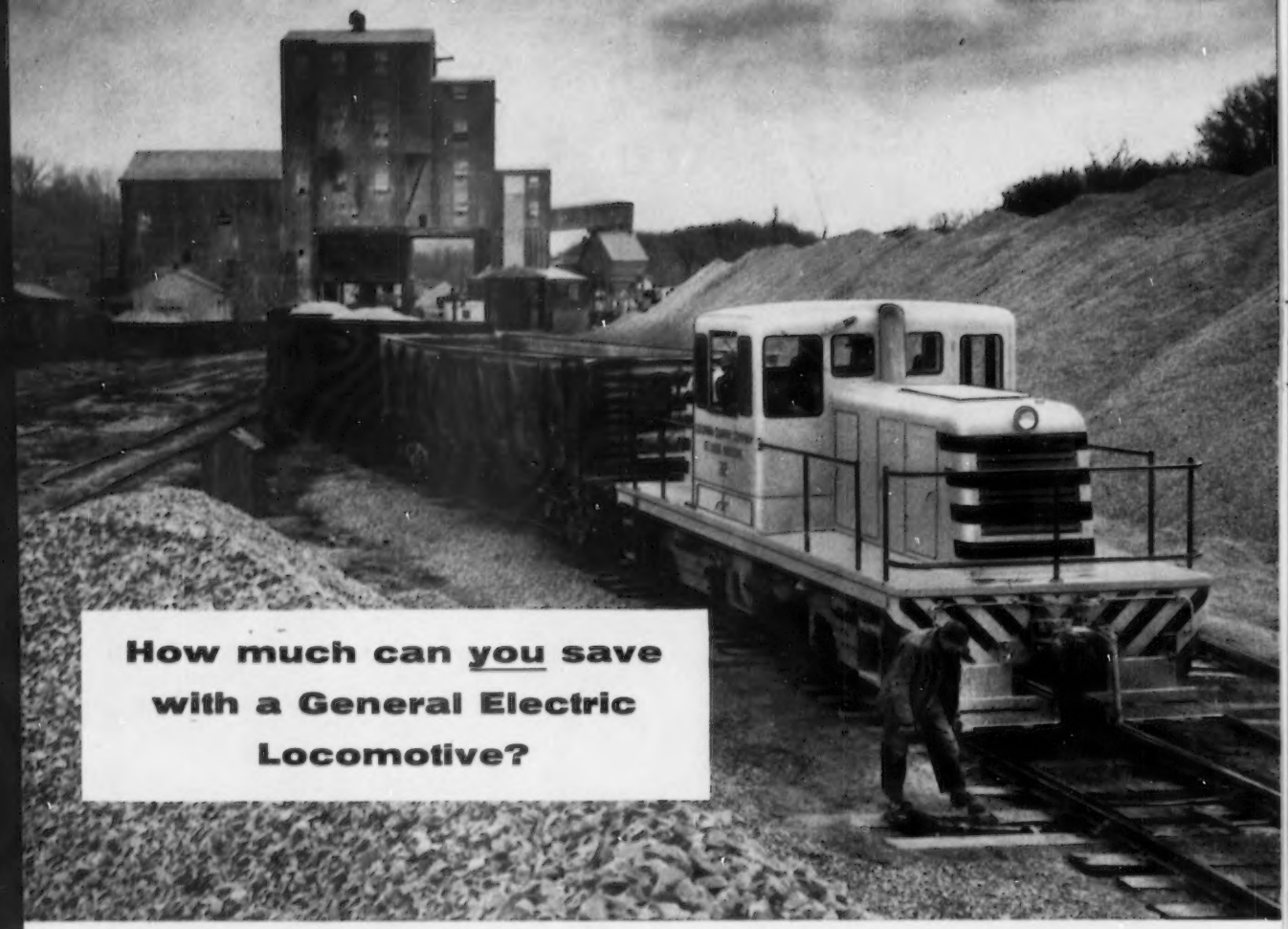
TRU-LAY VHS ropes are easy to order. Just ask for TRU-LAY VHS Shovel Hoist Ropes, Slusher Ropes or Draglines, in the size you want. You don't need any complicated specifications.

ACCO American Cable Division

AMERICAN CHAIN & CABLE

Wilkes-Barre, Pa., Atlanta, Chicago, Denver, Houston, Los Angeles, New York, Odessa, Tex., Philadelphia, Pittsburgh, Portland, Ore., San Francisco, Bridgeport, Conn.





How much can you save with a General Electric Locomotive?

AT COLUMBIA QUARRY COMPANY . . .

General Electric 50-ton Locomotives Haul 8000 Tons a Day and Cut Costs!

E. A. Heise, Superintendent of the Columbia Quarry Company's plant in Columbia, Illinois, says, "You just board a G-E diesel-electric locomotive and run it. It's always ready to go . . . ready to do the job!" Columbia is sold on their two efficient, powerful 50-tonners. In fact, they ordered a 35-ton G-E diesel-electric to replace a gas-mechanical locomotive at another location.

Yard switching and hauling crushed rock in the extremely dusty atmosphere of a limestone quarry and processing plant can be ruinous to any piece of machinery. Yet, G-E locomotives operate smoothly and well with minimum regular maintenance. And, **combined** maintenance and operating expense is just 1/3 what it was for former motive power!

Columbia Quarry Co. has realized big savings in track maintenance, too! Swivel-truck construction provides low weight per axle, permits the wheels to follow the rails freely, and reduces binding and straining on both the locomotive and the track.

WHAT ARE YOUR HAULAGE REQUIREMENTS? From the wide range of G-E industrial and mine locomotives—diesel-electric and straight-electric, for both underground and surface haulage, there's one fitted to your needs.

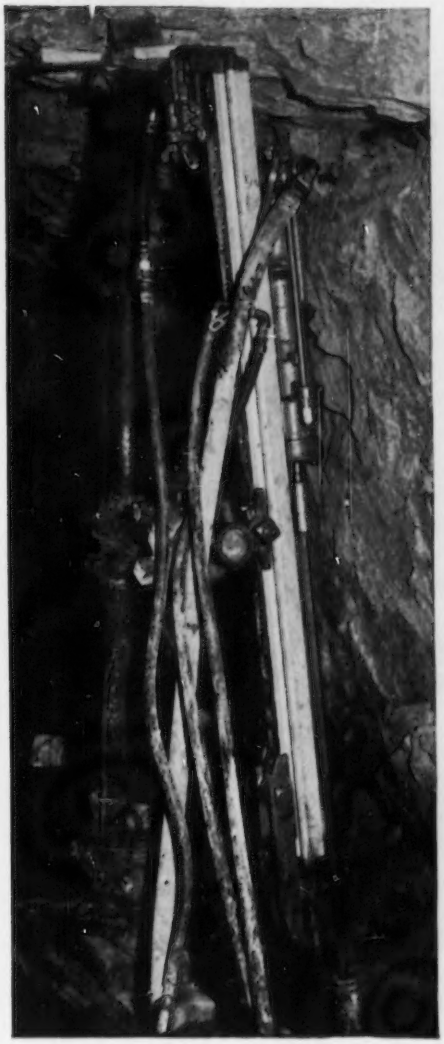
For a survey of your haulage requirements, without cost or obligation, contact your local G-E Apparatus Sales Representative. General Electric Co., Locomotive & Car Equipment Dept., Erie, Pa. 120-88

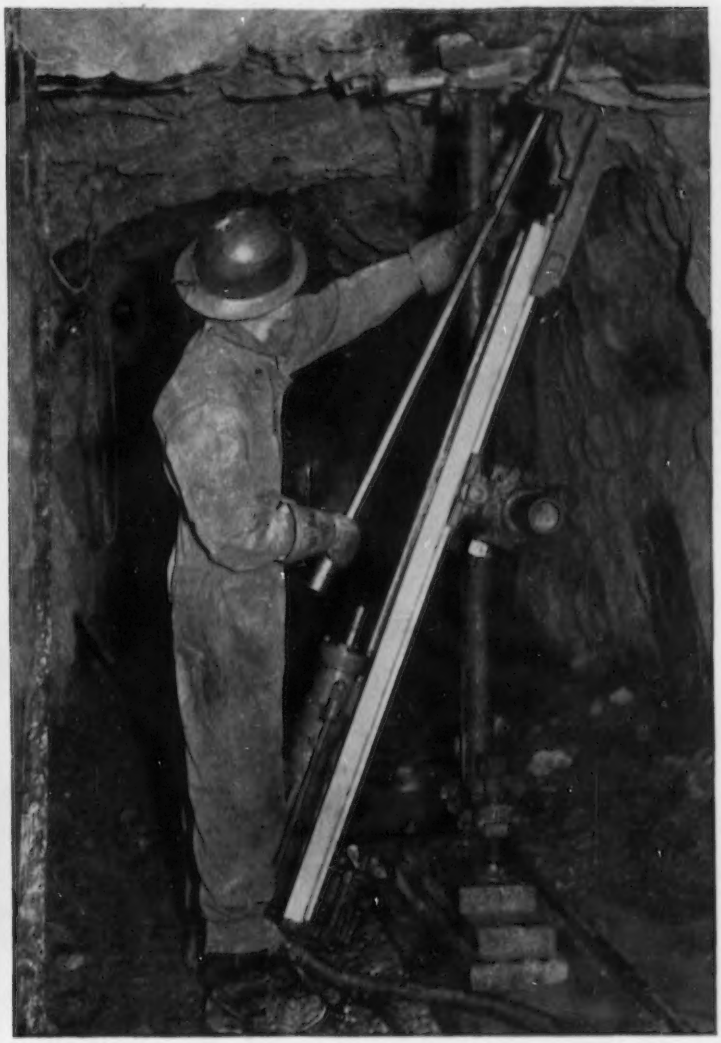
You Get
Longer Life,
Better Performance,
Lower Cost
WITH ELECTRIC DRIVE!

GENERAL ELECTRIC

Bits of Crucible Silicon-Manganese alloy steel shown in holder. They are produced by McLaughlin Manufacturing Co., Inc., Joliet, Illinois.

Gardner-Denver . . . Serving the World's Basic Industries





Reduce ore breakage costs by 50% to 75% with Gardner-Denver Deep Hole Drills

Permit ring drilling to 100 feet or more from a 7-foot development drift. Also for bench holes, stoping, slashing, pillar recovery.

Engineered deep hole equipment includes 4" or 4½" drills, long feed aluminum guideshells, Ring Seal Shank, sectional rods and couplings, bit adapter for carbide bits.

Send for illustrated bulletin on deep hole drilling . . . it's packed with application reports and equipment specifications.

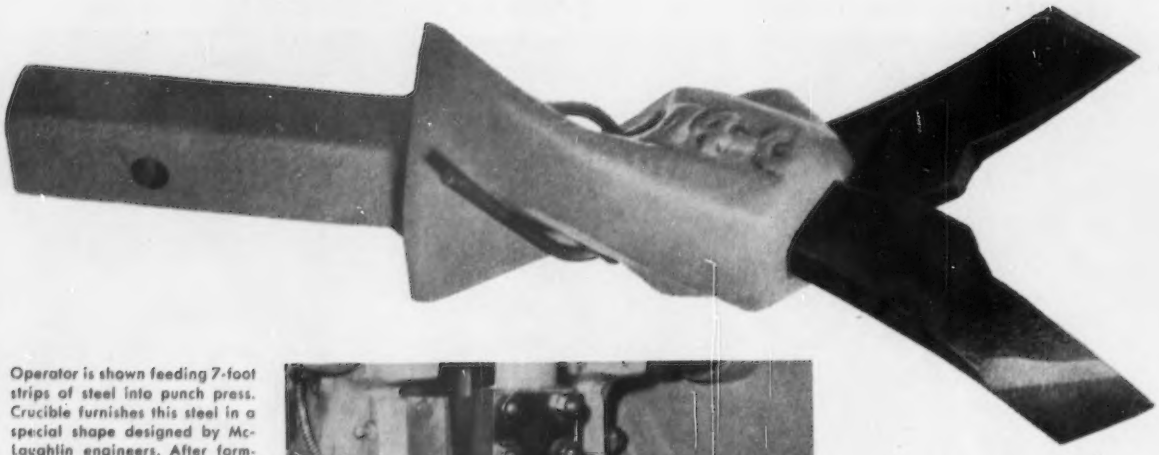
GARDNER - DENVER

THE QUALITY LEADER IN COMPRESSORS, PUMPS, ROCK DRILLS AND AIR TOOLS FOR CONSTRUCTION, MINING, PETROLEUM AND GENERAL INDUSTRY

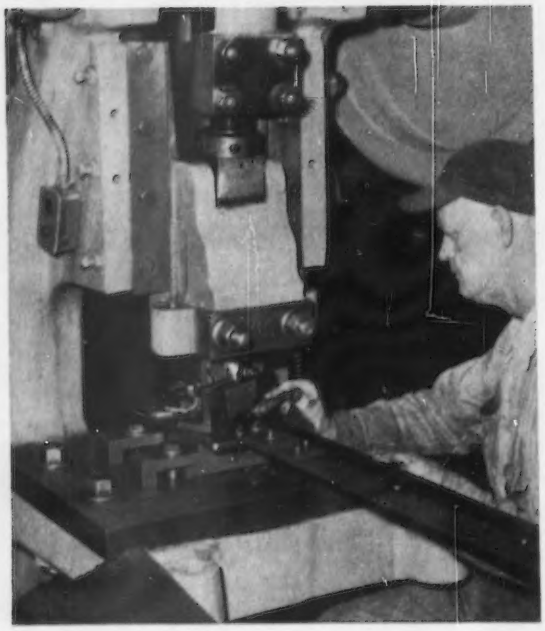
Gardner-Denver Company, Quincy, Illinois

In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario

Bits of Crucible Silicon-Manganese alloy steel shown in holder. They are produced by McLaughlin Manufacturing Co., Inc., Joliet, Illinois.



Operator is shown feeding 7-foot strips of steel into punch press. Crucible furnishes this steel in a special shape designed by McLaughlin engineers. After forming to finished size, the bits are heat treated and the point and cutting edge are sharpened by hand.



special
CRUCIBLE
alloy
steel

gives bits maximum impact and abrasion resistance . . .

Cutting through abrasive materials like coal, soft limestone and shale demands a *special* steel. A steel that's hard without being brittle – that will take and *hold* a keen edge.

That's why Crucible produces a *special* Silicon-Manganese type alloy steel for the McLaughlin Manufacturing Co., Inc., manufacturers of these bits. It's a steel designed for optimum shock and abrasion resistance.

After McLaughlin tested Crucible's special alloy in the coal fields, their verdict was "This Silicon-Manganese steel is the finest alloy steel available."

Crucible will be glad to produce a *special* steel to meet your particular needs, too. *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

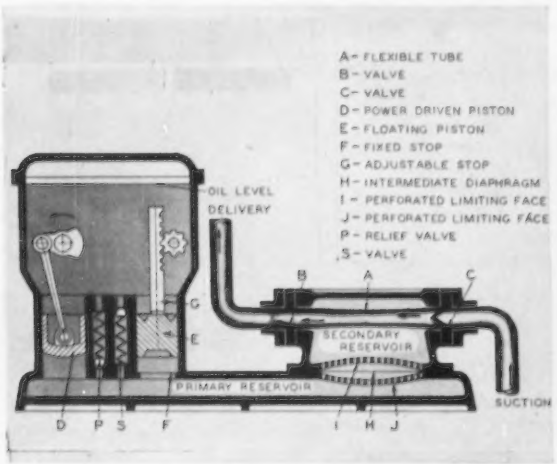
CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

E&MJ NEW PRODUCTS DIGEST

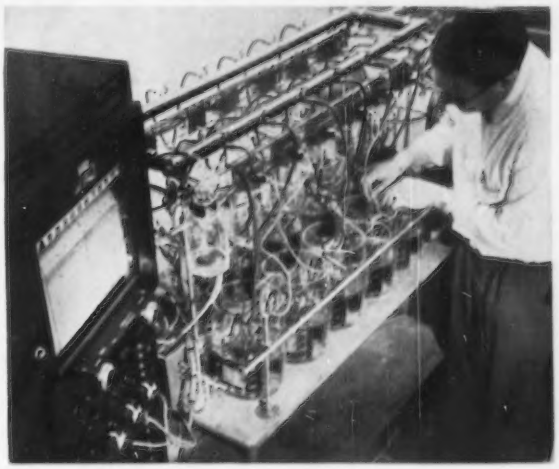
Giant Dump Trailer For West Virginia Mine

Ninety-five cubic yards of coal will be toted in each trip made by this mammoth dump trailer developed for West Virginia's Beckley Coal & Coke Co. Heralded as "the world's largest bottom dump hopper trailer," the truck is a combination of Kenworth Motor Truck Co.'s giant Model 803 2-axle tractor and a custom-built trailer designed and manufactured by the Marion (Ohio) Metal Products Co. The entire unit stretches to a length of 66 ft 5 in., weighs almost 50 tons (119 tons loaded), cost Beckley in the vicinity of $90,000. It features largest free-turning hitch ever made. **(1)**



Rubber Tube Pump (2)

Corroding liquids may be pumped safely with Yeoman Bros. Co.'s "Simpulsic" pump. Using a rubber tube which expands and contracts from the varying pressures of a surrounding reservoir of oil, the pump is designed so that the liquid being forced through never comes in contact with the metal parts. The Melrose Park, Ill., firm sees the "Simpulsic" being used for molten explosives, alkalies, slurries, viscous fluids. It can be regulated to deliver at any rate up to 7 gpm.



Fuel Cell (3)

By-product gases may be convertible into electricity soon, if experiments in the basic research laboratories of the National Carbon Co. continue [illegible]ve successful. Oxygen, being converted into positive charges in the above photo, and hydrogen, may provide charged particles for batteries which could be used for reserve power supplies. The fuel cells would run continuously as long as the gas supply continued, and are seen by the UCC division as ideal for remote stations.

Continued On Page 36. For More Information On Items, Use Card Opposite Page 42.

Front-End Loader (4, 5)

International Harvester's new TD-9 crawler tractor features a complete built-in scrubbing system, so compact that the entire tractor is only 6 ft high. The 71-hp diesel, designed for underground use, uses a standard 1½-cu yd bucket, features versatility through multitude of attachments.

American Tractor Corp., Churubusco, Ind., also has new crawler front loader out. Extra-large tilt-cylinders and worked-over dump mechanism give a "forced ejection" push especially handy for such sticky surfaces as muck and wet clay.

Tractor (6)

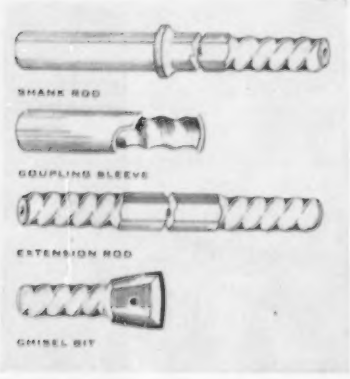
Snow, muskeg, swampland and sand wastes are fair ground for the Muskeg tractor according to manufacturers, Bombardier, Ltd., Valcourt, Quebec. For carrying workers or supplies, the tractor is powered by a Chrysler Industrial 115-hp engine, has a top speed of 25 mph. Two models: J, single-track job with 16 oz per sq in. ground pressure, and M, the double-track variant with only 12 oz per sq in. Both feature one-piece water-tight frame, flexible suspension, choice of 3- or 4-speed transmission, endless rubber tracks that run silently.

Drill Dust Collector (7)

Dust collection in overhead drilling is made easy and inexpensive with the M-S-A Drildust Bucket, according to Mine Safety Appliances Co. of Pittsburgh. Unit consists of a collecting pail, rubber hood, and support assembly. It slides over drill, remains in contact with roof. No external power needed as the dust simply falls into bucket, is dumped at the end of each drilling.

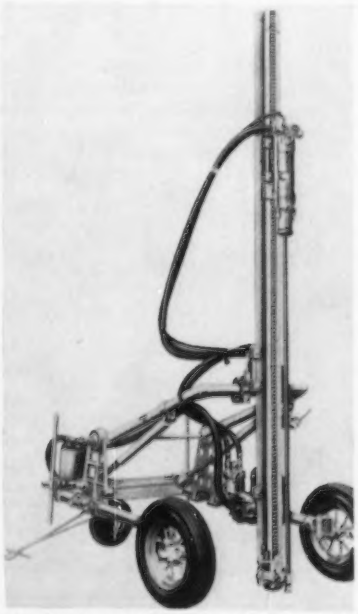
Slip-On TC Bit (8)

Removable tapered socket carbide insert bits being made by Timken Roller Bearing Co., Canton, Ohio. The rock bits give greater footages between sharpenings. Chip removal is easier because of the five front holes and the wider clearance between bit wings. Sizes: 1¼, 1⅜, 1½ in.



Drill Steel (9)

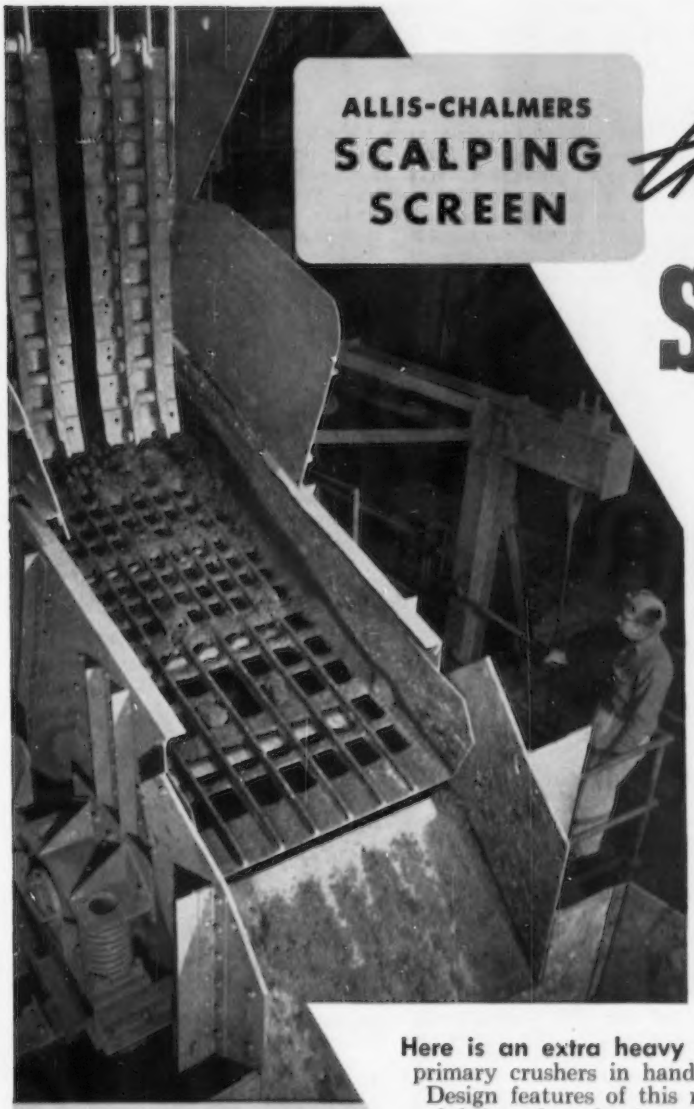
Extension steels that can be uncoupled by hand in most instances from the U. S. Atlas Copco companies. The rope-threaded Sandvik Coromant Swedish steels are said to do long-hole drilling for as little as 25c per ft. Collared for standard ⅞x4¼-in. chuck. Shank rods up to 8 ft 6 in.; extension rods, 2 ft 7 in. to 10 ft 6 in. Literature available.



Heavy-Duty Wagon Drill (10)

The feed shell is behind the center line of the large wheel axles in the latest heavy-duty wagon drill to come from Westinghouse Air Brake's Le Roi Division in Milwaukee. A welded tubular U bar adds extra strength. The drill, DR40, with feed shell and 4-in. drifter, weighs only 1500 lb. The three-wheel carriage uses two 6.00x16 tires and one 4.00x8 caster tire.

Continued On Page 38. For More Information On Items, Use Card Opposite Page 42.



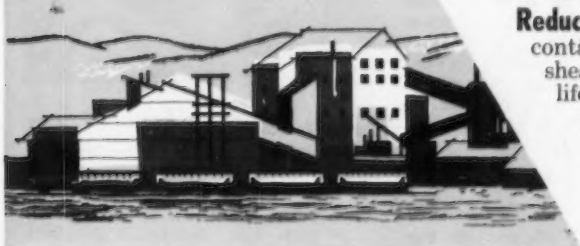
ALLIS-CHALMERS
SCALPING
SCREEN

the BIG SCREEN for the BIG JOBS

- **Extra-Large Mechanism**
- **12-inch I-Beam Deck Support**
- **Takes Punishing Loads**

Here is an extra heavy duty screen engineered to team up with primary crushers in handling the toughest job in any mining flow. Design features of this rugged screen include a cartridge-type, oil-lubricated mechanism with giant size bearings and a 12-inch I-beam in channel-constructed top deck support frame. The bearings, largest ever installed in a vibrating screen, are designed for long term service under heavy load conditions. The sturdy channel construction of the screen deck support frame can withstand the impact of single pieces weighing as much as 8000 pounds.

Performance proved on the *Mesabi* range . . . one of the toughest testing grounds in the world.



Reduced Maintenance — Simplified two-bearing, cartridge-contained mechanism can be pulled out after removing sheave and four bolts. Large size bearings mean extended life, less frequent replacement.

Vibration Isolation — Standard design includes multi-unit vibration isolators — two per corner, each with an inner and outer spring arrangement. Vibration to building or structure is isolated even when materials adhere to screen.

A-5051

For complete information, see your A-C representative or write for Bulletin 07B8368. Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

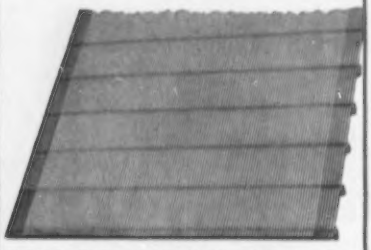
ALLIS-CHALMERS

Buy Valuable long life and economy that you can actually SEE...

Reg. U.S. Pat. Off.

Kleenslot

Wedge Wire Preparation Screens



WEDGE WIRE ALUMINUM SCREENS: They have all the attractive and sturdy features of many other metals besides aluminum and offer a flexing action that adds capacity and dewatering abilities which are almost unbelievable. It gives a distinct advantage where vibration is prevalent.

MARCEL TYPE SCREEN! This screen, as all WEDGE WIRE products, gives long life and non-blinding operation. Maximum dewatering efficiency is combined with a wavy type of screen preventing objectionable slivers passing through. This keeps the end product uniform.

Wedge-Wire CORPORATION

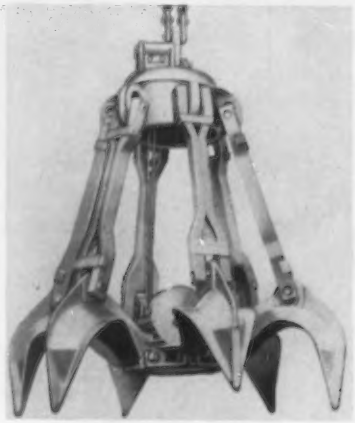
Gas Street at Nickle Plate R. R.

Wellington, Ohio

E&MJ NEW PRODUCTS DIGEST *(Continued)*

Drop Balls (11)

Drop balls that will last four times as long as those made of forged steel, according to developer Georgia Iron Works in Augusta, are made of GIW Ni-Hard metal. Worked out in cooperation with the International Nickel Co., the metal is said not to crack or chip. Balls are made in sizes ranging from 3,000 to 14,000 lb.



Grapple With Fingers (12)

Each tine of Philadelphia's Ruhr Industries' new M-1 grapple is independently and positively activated, designed for optimum vertical and angular movement. Final resistance is met with a grip of up to 50 tons. Sizes 0.33 to 3.3 cu yd.

Gear Remover (13)

Gears, and any other machine parts attached to a shaft or axle, can be expanded with this U-shaped heater from the Miskella Infra-Red Co., Cleveland, removed easily. 115v model with lamps: $135; 230v model: $210. Two heaters may be used together for faster heating.

Fish Tape Winder (14)

Pulling wire and cable through conduits with fish tape now can be an easier and safer job. Holub Industries, Sycamore, Ill., is marketing a winder that fits around the reel, is pushed forward to wind tape, pulled back to pay out. In finger grip design, the Tape-Mate fits 12-in. reels of ⅛-in. flat finish tape, sells for $2.75.

Grinding Mill (15)

New precision and efficiency in fine grinding is said to be possible with the Futura ball and pebble mill from the Paterson Foundry & Machine Co., E. Liverpool, Ohio. Accurate water temperature control is leading item in list of special features. Brochure available.

Truck Tires With Steel (16)

Truck tires especially designed for heavy service equipment have been announced by United States Rubber, New York City. A steel wire shield between tread and carcass is supposed to protect the tread and eliminate grooves cracking. Grooves are wide to cut down on stone retention, and the 3-rib tread is extra-deep for extra mileage.

Hand Hoist (17)

Atlas Copco Eastern's new air-powered chain block lifted nearly 20 times its own 55-lb weight in demonstrations at a Yonkers, N. Y., quarry. The Paterson, N. J., firm gives the hoist's lifting speed as 36 fpm. It operates from a ½-in. air line at 85 psi pressure, draws 1.6 cu ft of air per foot of lift.

Speed Starter (18)

A European device to provide quicker starting for gasoline and diesel engines is now available in the U. S. The Wilco Co., Los Angeles, and the Start Pilot Corp., Mineola, N. Y., distribute the attachment that injects a spray of ignition-promoting fluid into the intake manifold, keeps the engine firing until regular fuel source can keep up combustion.

Uranium Ore Analyzer (19)

A beta measuring instrument for field assaying uranium compound percentage in unknown ores is now being made by the Eberline Division of Santa Fe's Reynolds Electrical & Engineering Co. Such major units as the trigger-amplifier and high voltage units are removable with a screwdriver.

Pocket Calculator (20)

Aluminum pocket calculator just 3 in. in diameter is said to do work of a 10-in. slide rule. Made in Germany, the Controller is distributed in the U. S. by Silver Bells, Ltd., Oakland, Calif. With Vinyl carrying case, the disk weights only 1 oz, is said to be unaffected by climatic conditions. Will multiply, divide, figure fuel consumption, change inches to centimeters—anything but add and subtract. Costs $7.95.

Continued On Page 40. For More Information On Items, Use Card Opposite Page 42

Illustration from Agricola's De Re Metallica (1621)

Arduous Work—Small Production

In centuries past, the production of metals could be measured by handfuls. Small wonder when comminution was done by a hammer and beneficiation was limited to hand-picking.

Fortunately, today's modern processing plants treat many tons of ore and produce many tons of metals, thus making possible our "metal age" civilization. This large production requires modern grinding methods which in turn utilize such grinding media as those produced by CF&I. The grinding balls and grinding rods produced by CF&I are *always* made from special analysis steels with the ideal balance between toughness and hardness to assure optimum grinding ability and maximum wearing ability.

THE COLORADO FUEL AND IRON CORPORATION CF&I 3695

Albuquerque • Amarillo • Atlanta • Billings • Boise • Boston • Buffalo • Butte • Casper • Chicago • Denver • Detroit • El Paso • Ft. Worth
Grand Junction • Houston • Lincoln (Neb.) • Los Angeles • New Orleans • New York • Oakland • Oklahoma City • Philadelphia • Phoenix
Portland • Pueblo • Salt Lake City • San Antonio • San Francisco • Seattle • Spokane • Wichita • CF&I OFFICE IN CANADA: Toronto

Bottom Dump Mine Car (21)

Greater cu ft capacity in standard over-all dimensions is claimed for this one-door bottom dumping mine car from Sanford-Day Iron Works, Knoxville, Tenn. For narrow gage tracks, the car features clean shedding.

Displacement Valve (22)

Positive displacement valve designed to give more accurate measurement of liquid or gas flow is being sold by the Punxsutawney Co., Punxsutawney, Pa. The stainless steel units available for any specifications.

Power Pipe Threader (23)

New portable power drive of Toledo Pipe Threading Machine Co. styled for easier operation through relocated control switch. Changed ball bearing design lengthens service life.

Resuscitators (24, 25)

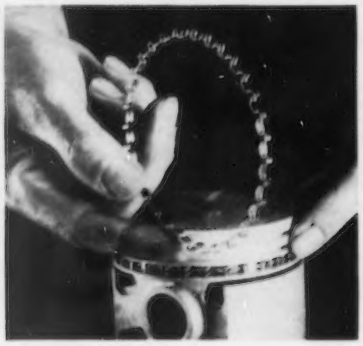
New portable resuscitators feature improvements. Air Force's Seeler valve is available for the first time commercially in the 30-lb unit from Fyr-Fyter Co., Dayton, Ohio. Fyr-Fyter claims the units sell for ¾ the price of others. The small breathing mechanism on Chicago's National Cylinder Gas Co.'s unit can be used 200 ft from the oxygen supply. The "Handy" weighs 26 lb without cylinders.

Vacuum Furnace (26)

Resistance heated uniform hot zone 36 in. in diameter and 36 in. high is provided for annealing reactive metals in vacuum furnace from NRC Equipment Corp., Newton Highlands, Mass.

Friction Clutch (27)

Gasoline and diesel engines in the 10- to 50-hp range can use new clutch which has disengagement speed about 400 to 500 rpm lower than engagement speed, allows idling without slippage. From Salsbury Corp., Los Angeles.



Piston Rings (28)

Stainless steel piston rings with an unusual design are being made by Sealed Power Corp., Muskegon, Mich., from Allegheny Ludlum Steel. More miles per quart of oil is chief advantage claimed.

Crane-Excavators (29, 30)

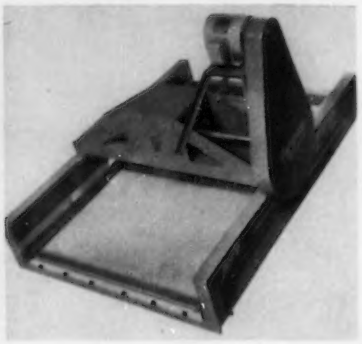
Convertibility of front end equipment without machinery change is a top feature of 35-M, ¾-yd shovel and 18-ton crawler crane from Ohio's Marion Power Shovel Co. Truck model is 35-MR. The heavy 35-ton job, MC530W from Thew Shovel Co., Lorain, Ohio, is powered by gasoline or diesel engines. Gives greater lift capacity without outriggers and better load distribution.

Battery Locomotive (31)

A rail tractor, battery driven, is something new in industrial handling custom-built by Pennsylvania's Easton Car & Construction Co. It will tow cars with a gross load of five tons. For 24-in. track.

Industrial Timer (32)

An industrial timer that consists of a synchronous electric unit that runs as long as there is power and a spring driven unit that takes over immediately in power failures is made by Industrial Timer Instruments Co., Chicago.



Vibrating Screen (33)

Space is saved in battery operation with high motor mount for Model E Leahy vibrating screen that permits swinging motor inward, leaving only drive guard as necessary projection. From Deister Concentrator Co., Ft. Wayne, Ind.

Sturdy Hose (34)

Industrial hose made of Teflon (tetrafluoroethylene) made by Aeroquip Corp., Jackson, Mich., is for uses where chemical action or wide temperature ranges are encountered. Handles fluid temperatures from —100 to 500 deg F.

Metallizing Gun (35)

Oxyacetylene gun from Metallizing Co. of America, Chicago, sprays Norton's Rokide oxide coatings on roughened surfaces, protects underlying metal from abrasion and excessive heat.

Shipping Containers (36, 37)

Corrugated steel shipping box from Republic's Pressed Steel Division, Cleveland, has collapsible sides, can be reduced to ⅛ original size for storage.

Containers for long items with relatively small diameters are being made by Geo. D. Ellis & Sons in Philadelphia. The cylindrical cans range in height to 60 in. Diameters: 5, 6½ and 8½ in.

Sight Glasses (38)

New developments at Corning Glass Works, Corning, N. Y., make possible glass windows hermetically sealed directly to almost any ferrous or nonferrous metal including brass and stainless steel. Windows unaffected by vibration.

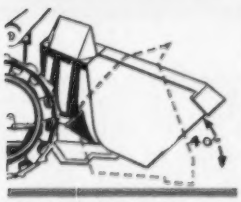
Wheel Winch (39)

A low cost wheel winch for four-wheel drive bucket loaders is being marketed by Termac, Libertyville, Ill. The versatile unit is designed for pit and quarry work as well as general construction. Model TOW 1.

Continued Opposite Page 42. For More Information On Items, Use Card On That Page.

SO FAST... YOU'D THINK IT WAS ON WHEELS...

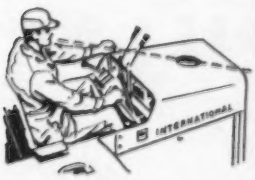
the all new Rear-engine 1¾ yd. International® Payloader®



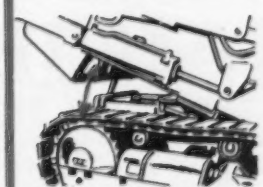
NEW PRY-OUT FORCE
International-built 77 net hp diesel engine, short-coupled power train, positive hydraulic action and 40° tip-back bucket on ground break-out pads combine to give tremendous pry-out force.

	1st	2nd	3rd
Forward	0-1.6	0-4.5	0-10.1
Reverse	0-2.1	0-5.7	0-13.1

NEW HIGH SPEEDS
The Payloader's top speed of 10 mph forward is nearly three times faster than most other competitive units. Top reverse speed of 13 mph is four times faster.



NEW VISIBILITY
Operator is always "on top of his work" because of rear-engine design. He works faster with less effort. To shift or steer, he pulls a hydraulic lever. There is no master clutch or steering pedals.

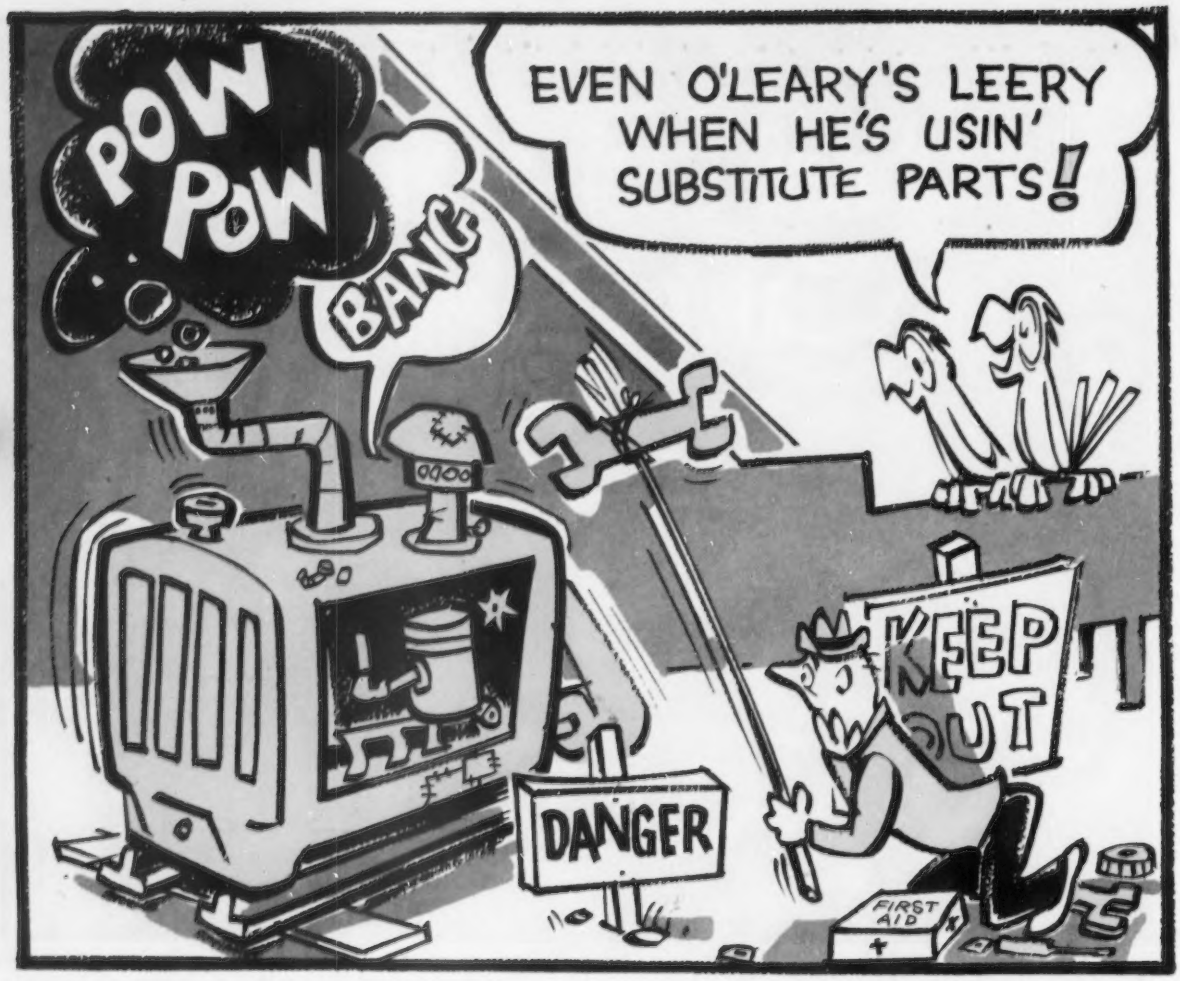


NEW SERVICIBILITY
Only tractor-shovel with tilting body, the Payloader permits mechanic to get at all four sides of engine easily and quickly. Tilting body for servicing takes only a few minutes.

Here's the new tractor-shovel that surpasses all competitive models for speed...gives you fastest loading cycles ...yet offers you crawler traction and stability for greater production and more profitable work in any terrain...in any weather. It's the all new, rear-engine, 1¾-yard International Model 12 Payloader...with new, high speeds, unmatched in crawler history...with new pry-out force necessary in rock and other tough materials...with new visibility, a result of rear-engine design...and new serviceability obtained by tilting the body to reveal engine and other components. See all these and many other International Payloader features at your International Construction Equipment Distributor, soon. Then try it! It's so fast...you'll think it's on wheels.

INTERNATIONAL® CONSTRUCTION EQUIPMENT
International Harvester Company
180 North Michigan Avenue, Chicago 1, Illinois

A COMPLETE POWER PACKAGE INCLUDING: Crawler, Wheel, and Pipe-Boom Tractors . . . Self-Propelled Scrapers and Bottom-Dumps . . . Crawler and Rubber-Tired Loaders . . . Off-Highway Trucks . . . Diesel and Carbureted Engines . . . Motor Trucks.



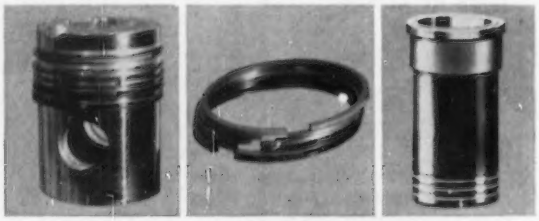
Somebody mention replacing a piston? Remember . . .

Caterpillar pistons are of special aluminum alloy—light, yet extremely heat-resistant and strong. CAT* rings are cast from fine grain alloy iron; their honed sides and lapped faces mean better sealing, smoother break-in. *Chrome*-plated rings offer increased resistance to wear. And 21 complete quality-control checks insure the fit, performance and long life of each Cat liner. You're sure of top quality, throughout.

With substitute parts, can you be sure of anything?

Better see your Caterpillar Dealer's Parts Representative—and get Cat original parts every time.

Caterpillar Tractor Co., Peoria, Illinois, U.S.A.



Cat pistons, rings and liners are the result of years of Caterpillar experience and research. Their thousands of trouble-free working hours can cut your operating costs substantially. Why take a chance with substitutes?

CATERPILLAR*

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

Solder Fluxes (40)

Solder fluxes, quick wetting, designed primarily for copper and copper-base alloys, use hydrazine, are non-corrosive. From ASARCO's Federated Metals, New York City.

Conversion to Gas (41)

Kits to change Caterpillar D386 and D364 diesels into gas-burning, spark-ignition engines for more horsepower and lower costs are available from the Peoria firm.

Tube Rod Electrodes (42)

Tube rod electrodes, adaptable for most semi-automatic welders, were developed for hardfacing by the American Manganese Steel Division of American Brake Shoe Co., Chicago Heights, Ill.

Conveyor Belt Scale (43)

Unitized weighing belt conveyor scale specifies 1 part in 2,000 repeatability and 1 part in 5,000 sensitivity. From Weighing and Control Components, Inc., Hatboro, Pa.

Detergent (44)

Neither free caustic nor inert material is in "highly alkaline" cleaning agent for all industrial use, says John B. Moore Corp., Nutley, N. J.

Mobile Generators (45)

Portable power, permanently housed in a tractor-trailer unit, is available in 350 and 500 kw sizes. Trailers are Fruehauf's 145-in. wheel base jobs, whole generator unit comes from White Motor Co.'s Diesel Engine Div., Springfield, Ohio.

For Your Files

This informative manufacturers' literature is free unless otherwise specified. To obtain bulletins circle their numbers on card at right and mail.

CONVEYOR PULLEYS are detailed in new loose-leaf punched bulletin from R&J Dick Co., Inc., Passaic, N. J. Barry solid steel "QD," "H" and "L" conveyor pulleys, lagged pulleys, and type "S" split steel pulleys are covered. **(55)**

ROOF BOLTING TECHNIQUES are put in the spotlight in latest issue of "Haulage Ways," periodical issued by Ohio Brass Co. of Mansfield. Such subjects as effect on bolt tension of wood headers and bolt diameter are discussed. **(56)**

BUILDINGS adaptable for offices, warehouses, processing operations are shown in catalogue 56-1-109 from Detroit's Stran-Steel Corp., manufacturers of rigid frame, metal wall units in widths from 32 to 80 ft. **(57)**

SEMINARS on heat-resistant alloys held at Elyria, Ohio, are featured in the lead article of "Metal Trends," American Brake Shoe Co. magazine. Manufacture and use of Thermalloy family formed center of discussion. **(58)**

MATERIALS HANDLING and power transmitting equipment of Link-Belt Co., Chicago, are detailed in new comprehensive directory, No. 2653. Profusely illustrated. No. 2665 covers Link-Belt mill bearings; line now includes bearings for shafts up to 11 in. diameter. **(59, 60)**

SPECTROSCOPIC electrodes and powders made by UCC's National Carbon Co. are shown in 16-page catalogue A-4004. Engineering drawings of the electrodes and caps included. **(61)**

COUPLING SELECTOR CHART, distributed by Morse Chain Co., Ithaca, N. Y., speeds picking proper flexible couplings. The 2-color, 22x17-in. chart lists bore diameters along top, shaft sizes down sides, color keys the intersections. **(62)**

GEAR SERVICING continues to get a thorough examination by C. W. Miller in the second installment of his article in "Maintenance News" (Vol. 20, No. 1), put out by Westinghouse Electric in Pittsburgh. **(63)**

MOTOR GRADER OPERATION is reviewed in detail in 32-page illustrated pocket-size manual issued by Peoria's Caterpillar Tractor Co. Form DE628 available in Spanish, French and Portuguese as well as English **(64)**

ENGINEERING DRAWINGS diagramming acid-proof masonary construction pump bases, tank outlets, column pads, bell and spigot joints, floors and trenches are being given out by Pennsylvania Salt Mfg. Co., Philadelphia, Pa. **(65)**

FLUID POWER'S applications in industry are treated in a lively booklet issued by the National Fluid Power Assn. and available from the Miller Fluid Power Division, Melrose Park, Ill. **(66)**

VIBRATION isolation efficiency curve to aid in picking flexible mounting system to give optimum noise and vibration control is obtainable from Lord Mfg. Co., Erie, Pa. **(67)**

HEATER LINES are described in new all-inclusive catalogues: 27-620 from Westinghouse Electric, Pittsburgh, Pa. **(68)** and 83 (radiant glass, tubular infra-red, and convection) and 84 from

OCT. 1956

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7	21	35	49	63	77	91
8	22	36	50	64	78	92
9	23	37	51	65	79	93
10	24	38	52	66	80	94
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8	22	36	50	64	78	92
9	23	37	51	65	79	93
10	24	38	52	66	80	94
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13	27	41	55	69	83	97
14	28	42	56	70	84	98

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Company .....

Address .....

E&MJ NEW PRODUCTS DIGEST *(Continued)*

Can Arm Corp., Champlain, N. Y. **(69, 70)**

FRACTIONAL HP MOTORS are given characteristic and performance rundown in new binder-size chart illustrating such data as speed-torque curves. From Howard Industries, Racine, Wis. **(71)**

CARBIDE PERCUSSION BITS made by Vascoloy-Ramet Corp., Waukegan, Ill., for severe wear applications are listed in catalogue VR-486. **(72)**

DUMP TRAILER UNITS called "Frameless" are among products featured in new folder issued by Anthony Co., Streator, Ill. Complete specifications and load ratings included. **(73)**

DRIVE SPROCKET RIMS and other tractor replacement parts made in tough manganese steel by the American Brake Shoe Co., Chicago Heights, Ill., are illustrated in new pamphlet from their AMSCO Division. **(74)**

FURNACE AND OVEN CONTROLS from Industrial Division of Minneapolis-Honeywell, Philadelphia, are catalogued in publication B43-1, spotlighting instrumentation in metal processing. Includes price list. **(75)**

CUTTING HEAT - TRANSFER COSTS with their Platecoil units is the subject of Bulletin LP-356 from Tranter Mfg., Inc., Lansing, Mich. Photos, specifications, and conversion tables are included. **(76)**

INDEXED AND ILLUSTRATED DIRECTORY of products and plans of Colorado Fuel & Iron Co. now off the press. Among items: hot-rolled steel, rails, wires, screening, processing belts. 70 pages. **(77)**

UP-DATING HOSE DATA, B. F. Goodrich of Akron has issued a 2-page, binder-punched bulletin on its Maxecon and other air hoses. Supplements earlier issues, No. 3460. **(78)**

DOCTORING SICK COMPRESSORS is easier with pamphlet PC-509 P from Worthington Corp., Harrison, N. J. Cartoon-filled publication details common compressor troubles, suggests possible causes. **(79)**

TORQUE CONVERTER CAPACITY CHART and a discussion of the background, design, and uses of the converters are included in folder 468 of National Supply Co., Pittsburgh. **(80)**

WELDING EQUIPMENT made by Modern Engineering Co., St. Louis, is listed with prices in 1956 revision of catalogue 150. **(81)**

CAREER PLANNING MISTAKES are discussed in "Seeds for Success," Career Development Council booklet available from Executive Job Counselors, Inc., New York City. **(82)**

AMERICAN STANDARDS ASSN., New York City, explains the three ways a standard may become accepted in new 20-page book for anyone interested in knowing the reason for the ASA or its mode of operation. **(83)**

INSTRUMENTATION for controlling, recording and indicating can be simpler and more flexible than ever before, according to Bulletin F-403 describing products of Fielden Division, Robertshaw-Fulton Controls Co., Philadelphia, Pa. **(84)**

CHEMICAL PROCESS PUMPS with the emphasis on interchangeability of components are shown in Bulletin B-1608 from Peerless Pumps, Los Angeles. Both grease and oil lubricated pumps come in discharge sizes 1 through 4 in. **(85)**

STATIC ELECTRICITY removed by compound from Merix Chemical, Chicago, from plastics (No. 79) and fabrics (No. 79-OL). Described in brochure No. 3. **(86)**

VALVE reducing pressure for gas or liquids operating up to 4,000 psi is detailed in Newark's Atlast Valve Co. data sheet 1A-71. Valve designated as No. 385, Type F. **(87)**

PROTECTIVE COATING for exterior masonry is made by Wilbur & Williams Co., Brighton, Mass. Their rubber acrylic coating, in white and ten colors, is touted in new folder. **(88)**

BABY COMPRESSOR, a 85-cfm size, has been added to Ingersoll-Rand's Gyro-Flo line of portable rotaries. The New York City firm has issued pamphlet 2307 about it. **(89)**

MOTOR BULLETINS from Allis-Chalmers, Milwaukee, describe latest developments in open drip-proof (51B6210G), totally-enclosed fan-cooled (51B7225D), and explosion-proof (51B7286G) units. Each publication gives dimensions, ratings and other data. **(90, 91, 92)**

PHOSPHATING and metal protective coating materials made by Turco Products, Los Angeles, are explained and charted in clear folder. **(93)**

STICKY MATERIALS are continuously fed with Com-Bin-Feeders described and illustrated in condensed catalogue 5607 from Pulva Corp., Perth Amboy, N. J. **(94)**

HEAVY DUTY HAND TRUCKS, tubular steel construction, are made in 16 styles by Milwaukee Truck Co. Dimensional specifications and pictures of each are included in brochure 453. **(95)**

CYCLE COUNTER, from Alemite Division of Chicago's Stewart-Warner Corp., designed for use with a accumatic valves in central lube system to give full record of bearing lubrication is presented in binder sheet 32-24. **(96)**

TANDEM AXLE UNITS for six-wheel trucks and in trailer installations where equal load distribution is important are made by Hendrickson Mfg. Co., Lyons, Ill., described in 4-page bulletin 502. **(97)**

Keep it up!

The life you save may be your kid's!

THE ENSIGN-BICKFORD COMPANY

Simsbury, Connecticut

Manufacturers of Primacord® Detonating Fuse, Ignitacord® Quarrycord, Blasting Accessories -- and Safety Fuse since 1836

INTEGRAL TYPE — is primarily designed for production drilling. It is used in combination with the CP-32 AW Sinker for general Airleg work. For harder formations and deep-hole drilling it is combined with the CP-59 W Sinker. Provided with push-button releases at both ends of Sinker handle.

ATTACHABLE TYPE — is a time saver for the sinker drill operator who frequently has to do lateral or overhead work. Used with the CP-39 Sinker for soft to medium formations; the CP-32A Sinker for general Airleg work; and the CP-59 Sinker for hard formations or deep-hole drilling. Safety push-button release is in feed throttle handle.

get **FASTER FOOTAGE** *in every formation*

CP Integral and Attachable Airlegs are designed to get the most out of Tungsten Carbide bits by keeping bit pressure constant even when line pressures or rock formations vary. Because of their exceptional control the pressure-balanced legs take recoil shock in stride... reduces bit slapping and drill breakage. Assures smoother handling of drills. Standard feeds for both types are 36″ and 48″. For more complete Airleg information write direct to *Chicago Pneumatic Tool Company, 8 East 44th Street, New York 17, New York.*

Chicago Pneumatic

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

The Engineer's Field Report

CASE HISTORY
LUBRICANT RPM Delo Oils
FIRM Progressive Transportation Co., Compton, California

RPM DELO holds piston wear to .001" after 201,253 miles of on-and-off highway hauling

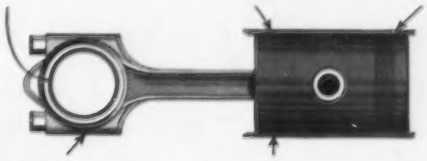
LUBRICATED WITH RPM DELO Oil, these engine parts were pulled from a Cummins HR diesel after 201,253 miles. A portion of this mileage was put on during four months of rugged service spotting loads of heavy pipe in the Arizona desert. When the engine was taken down, after two years of this on- and off-highway hauling, Progressive Transportation Co. found RPM DELO Oil had kept lacquer, gum, sludge, and deposits from forming...rod bearing wear varied between .0005 and .001 inch and pistons showed maximum wear of only .001". No wear at all evident on main bearings. Progressive Transportation uses RPM DELO Oils in all its large fleet of tractors—some of which have traveled well over 200,000 miles without overhaul.

Why RPM DELO Oils prolong engine life

Special compounds stop corrosion

Anti-oxidant resists lacquer formation

Detergent keeps all parts clean



Metal-adhesion qualities keep oil on parts in running or idle engines—inhibitor resists foaming

LUBRICATING OILS RPM DELO

For More Information... about this or other petroleum products of any kind, or the name of your nearest distributor, write or call any of the companies below.

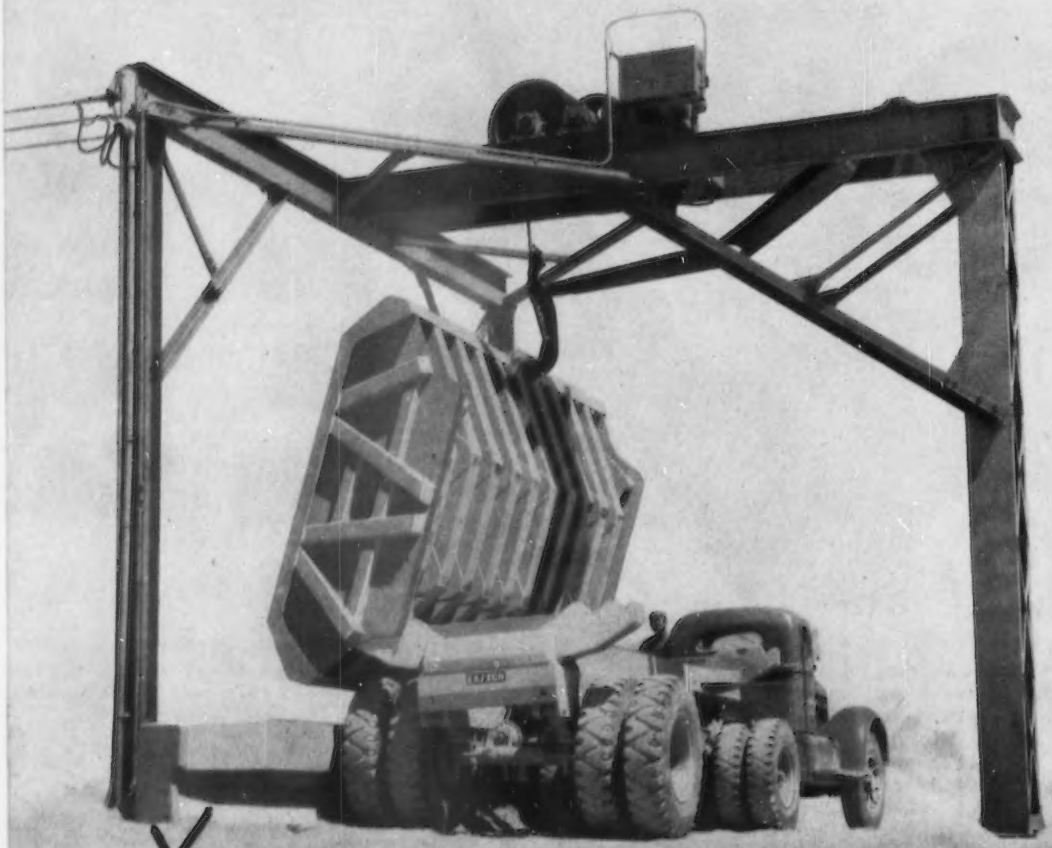
STANDARD OIL COMPANY OF CALIFORNIA, 225 Bush Street • San Francisco 20, California

THE CALIFORNIA COMPANY, P. O. Box 780 • Denver 1, Colorado

STANDARD OIL COMPANY OF TEXAS P. O. Box 862 • El Paso, Texas

THIS is the way to make bigger profits

For economy, dependability and productivity you won't match this combination anywhere

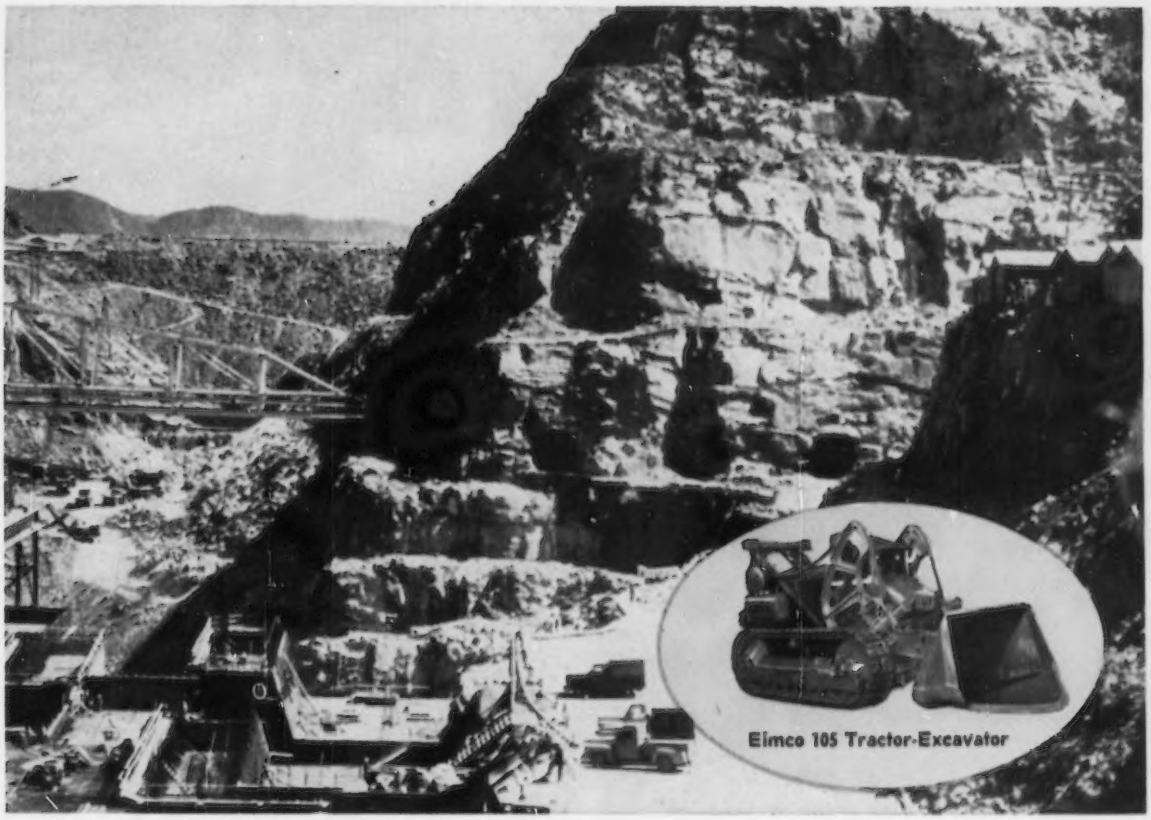


Exclusive EASTON Automatic Electric Overhead Hoist Used in Combination with EASTON Pan Type Side Dumps

Write or telephone for technical information

EASTON

EASTON CAR & CONSTRUCTION COMPANY • EASTON, PA.



INDIA – EIMCO 105's KEEP GRUELLING SCHEDULE

Two Eimco 105 Tractor-Excavators have each worked 8,000 hours in 12 months to keep progress on schedule at a huge dam project in India.

The machines have received intelligent maintenance and repairs have been small.

Eimco 105 Tractor-Dozer

At work on diversion, penstock and highway tunnels, trained Indian crews operating the 105's are doing an excellent job of tunnel driving. In some instances, advance for the size of tunnel being excavated may establish new world records.

"Eimco 105's are preferred equipment to use for tunnels of this type," says one official of a contracting firm. "The transmission, clutches and drive on both machines have not been touched in 8,000 hours of operation. They are in good condition and we expect them to last many more years."

Have you considered why the Eimco 105 is "preferred equipment" to contractors of huge dam, tunnel and road projects in the export market?

It's becauuse their dependability is reflected through their engineered strength to stay on the job around the clock – day in and day out.

The Eimco 105's dependability eliminates the necessity of a sizeable parts depot. Eimco's are built to 100,000 hour standards for service in remote areas. Time saved by Eimco's working continuously with no down time for repairs is a big factor in selecting equipment.

Conditions being equal, Eimco 105's will produce more at less cost and in less time than comparative equipment. Let Eimco show you how this versatile unit can outperform and out-work heavier, more expensive units.

See the Eimco 105 before you buy any crawler tractor equipment.

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

New York, N. Y. Chicago, Ill. San Francisco, Calif. El Paso, Tex. Birmingham, Ala. Duluth, Minn. Kellogg, Ida. Baltimore, Md. Pittsburgh, Pa. Seattle, Wash. Cleveland, Ohio Houston, Texas Vancouver, B. C. London, England Gateshead, England Paris, France Milan, Italy Johannesburg, South Africa

B-214

NEW SUPER MILEAGE LUG TIRE CUTS YOUR HAULING COSTS

—— PULLS BETTER OFF ROAD, TOO!

Here is a new Firestone tire that will cut your operating costs to the barest minimum.

On hard paving, its deep-ribbed, wide center treads move along smoothly without the tire-wearing, equipment-killing vibrations so often set up by ordinary type heavy-duty tires. As a result, you get more original tread miles. And, heavy lug bars give you all the pulling power you need for off-the-road duty.

Firestone Super Mileage Lug tires have 60% deeper tread to give you more low-cost miles. More than that—they are built with husky, Safety-Tensioned *Gum-Dipped*® cord bodies. This exclusive Firestone process gives a stronger tire body and makes it possible to get more retreads on every tire.

Any way you look at it, you'll save money with Firestone Super Mileage Lug tires! If you operate dump trucks, cement mixers, logging, mining or any other heavy-duty trucks, it will pay you to contact your Firestone Dealer or your Firestone Store now for the best deal you ever got on the longest wearing, most dependable tire ever built for on- and off-the-road performance!

Test after test proves you get extra original tread miles and more retread miles at lower cost with Firestone Super Mileage Lug Tires.

DEEPER TREADS LAST LONGER!

WHEN YOU BUY NEW EQUIPMENT OR REPLACEMENT TIRES SPECIFY **Firestone**

Enjoy the Voice of Firestone on radio or television every Monday evening over ABC.

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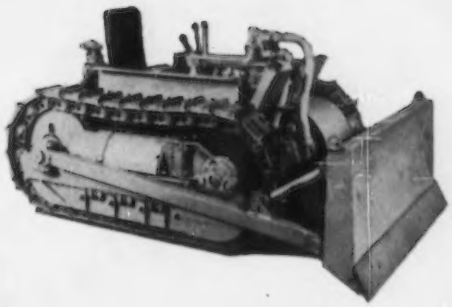
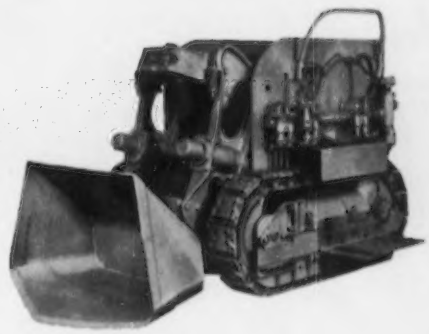
NOW! IN CRAWLER TYPE MACHINES FOR TRACKLESS WORK, THE SAME HEAVY RUGGED CONSTRUCTION AND DEPENDABILITY THAT THE INDUSTRY HAS HAD IN EIMCO WHEEL TYPE MACHINES.





Fast, sharp maneuvers, regulated by fingertip control make the EIMCO 630 EXCAVATOR a production giant and an operator's delight.

With the power at his fingertips to move one track into forward motion while the other is in reverse motion, an operator can make the 630 veritably "walk" around a muck pile—working from any angle without backing to make a new approach.

Eimco 630 agility permits operators to quickly master movement of the machine to a point that lost motion is eliminated between excavating and discharge stages.

While the 630 is moving between points of excavation and dumping, the bucket progressively elevates in an arc. Through proper timing, arrival of the 630 and bucket discharge become simultaneous operations. And the large half-yard bucket provides greater tonnage at every discharge.

These three pluses—extra maneuverability, operational ease and larger bucket capacity added in terms of economic value to you mean MORE TONNAGE IN LESS TIME.

B-215

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

New York, N. Y. Chicago, Ill. San Francisco, Calif. El Paso, Tex. Birmingham, Ala. Duluth, Minn. Kellogg, Ida. Baltimore, Md. Pittsburgh, Pa. Seattle, Wash. Pasadena, Calif. Houston, Texas Vancouver, B. C. London, England Gateshead, England Paris, France Milan, Italy Johannesburg, South Africa

World's Largest Shovel is the Mountaineer, built by Marion Power Shovel Co. for Hanna Coal Co. It is 16 stories high, and scoops up overburden in 90-ton bites. USS "T-1" steel is specified for such major components as the bucket, dipper stick and crowd rack; to assure the strength, toughness and ruggedness that adds up to long service life.

"T-1"...a super-tough nickel alloyed steel prevents breakage...slashes downtime

At 38°F below zero...or at 900°F above..."T-1" steel stays *super-tough!*

Downtime troubles *go out* when "T-1" steel *goes in* dipper sticks, shovel buckets, car bottoms, bulldozers and other mining equipment.

That happens because "T-1" steel is a constructional alloy steel combining exceptionally high levels of strength and toughness. It stands up under heavy shock loads. Curbs breakage the year 'round.

Note its advantages:

90,000 psi minimum yield strength.

Readily weldable . . . needs no preheat nor stress relief.

Resists impact at sub-zero temperatures.

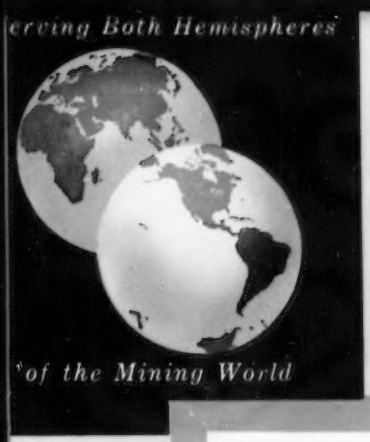
Four times as resistant as carbon steel to atmospheric corrosion.

Use "T-1" steel for heavily stressed parts. Watch them stay on the job, earning profits. Why take chances with steel of lower yield strength and consequent risk of failure in service? Idle men and machines make it a costly proposition...so, put "T-1" steel to work now.

For details on USS "T-1" steel, write to United States Steel Corp., Pittsburgh 30, Pa.

INCO TRADE MARK **THE INTERNATIONAL NICKEL COMPANY, INC.** 67 Wall Street New York 5, N. Y.

PRINTED IN U.S.A.



CYANAMID

REAGENT NEWS

"ore-dressing ideas you can use"

Slime Filtration Improved With AEROMINE® 2026 Promoter

AEROMINE 2026 Promoter is being used to solve a troublesome filtration problem resulting from clay-type minerals dispersed in water. Ranging in size from 5 microns down, these particles are very difficult to filter.

Addition of 0.3 to 0.5 lbs. of AEROMINE 2026 Promoter per ton of dry solids has increased filter capacity 20 to 35%. AEROMINE 2026 Promoter is best added as a 5% water solution to a mixing tank ahead of the filters. Only gentle mixing is necessary, since violent agitation (such as developed in centrifugal pumps) breaks up the flocs and decreases effectiveness of the AEROMINE 2026 Promoter.

At this particular operation, a variety of methods was used in an attempt to solve the problem before standardizing on AEROMINE 2026 addition. Adjustment of pH by addition of lime, or the use of alum or other standard chemicals had little effect. Nor did the powerful synthetic polymers, the AEROFLOC® Reagents, give any considerable increase in filtration capacity. AEROMINE 2026 Promoter, a cationic flotation collector, did the job. AEROSOL® C-61 Surface Active Agent, a cationic, improved the filtration rate, but AEROMINE 2026 Promoter was more economic.

Perhaps AEROMINE 2026 Promoter, AEROSOL C-61 Surface Active Agent, or the AEROFLOC Reagents can be used to solve your slime filtration or settling problems. A post card or letter to our nearest office will bring you samples for testing.

AMERICAN CYANAMID COMPANY
MINERAL DRESSING DEPARTMENT
30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.
Cable Address — Limenitro, New York

NORTH AMERICAN CYANAMID LIMITED
160 Bloor Street East, Toronto 1, Ontario, Canada
CYNAMID DE MEXICO, S. A.
Apartado No. 26012, Mexico 12, D. F., Mexico

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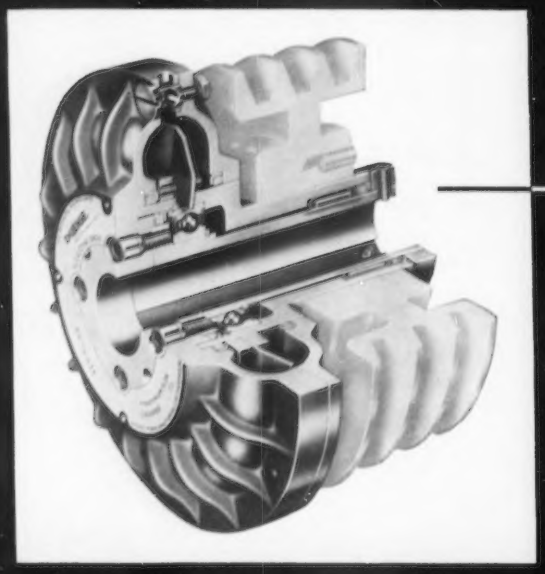
E. P. CADWELL, Belen 1043,
Of. 6, Lima, Peru
G. B. O'MALLEY, MALCOLM GLEN,
377 Little Collins St., Melbourne C. 1, Australia



Great Performance!

– is the verdict from the field on

FLEXIDYNE

THE DRY FLUID DRIVE

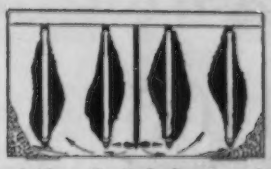
Experience in the field proves that the new principle employed in Flexidyne provides a better way to handle difficult drive problems. Now delivered from stock, Flexidyne Drives and Couplings are used in a wide variety of applications. Already reports like these are coming in about Flexidyne performances in many tough assignments:

RAILROAD CAR PULLERS... *"Starts fine . . summer or winter!"*
CONVEYORS... *"We start under full load now!"*
COTTON CARDS... *"Finally . . the soft start!"*
TRAVELING CRANES... *"Spots our load . . and how!"*
PUMPS... *"Now we are using smaller motors, too!"*
VENTILATING FANS... *"Takes off smooth as silk!"*
...AND OTHER HEAVY INERTIA LOADS... *"Wonderful performance!"*

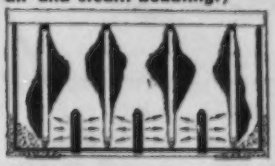
Call the Transmissioneer, your local Dodge Distributor, for details about Flexidyne. Factory-trained by Dodge, he can give you valuable assistance on new, cost-saving methods. Look for his name under "Power Transmission Machinery" in your classified telephone directory, or write to

DODGE MANUFACTURING CORPORATION, 3100 Union Street, Mishawaka, Indiana

DODGE
of Mishawaka, Ind.



Function of "impeller" design is agitation thru stirring. Results: Cake scour and uneven formation; vacuum loss at thin sections near the periphery of disc. (Other methods included pipes for air and steam bubbling.)



This "rake oscillating agitation" design (from drum filters) is equipped with upright pieces of various shapes to increase agitation. The result: Cake scour and uneven formations due to direction of thrust.

The Eimco Agidisc method now used provides agitation straight-up between the discs, giving the many advantages listed in text at right.

EIMCO AGIDISC FILTERS HAVE EXCLUSIVE ADVANTAGES

Eimco Hy-Flow Agidisc Filters give you these important advantages:

1) Even cake distribution without segregation. **2)** Uniform thickness and dryness. **3)** Higher tonnage capacity per square foot of filter area. **4)** Dryer cake. **5)** Clean discharge. **6)** Longer media life. **7)** Lower maintenance costs.

After Eimco pioneered the agidisc filter, other manufacturers tried to match its performance by adding attachments to their existing filters.

Sketches at left readily show disadvantages of makeshift agitation.

The Eimco Agidisc is NOT a "patched up" version of other filter designs with doubtful operating merits. It is an integral unit. Scientific planning went into its distinctive design. Advantages were test-proven before it was marketed.

Confirmation that these filters are producing the advantages for which they were designed, is being received every day from Eimco Agidisc users.

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

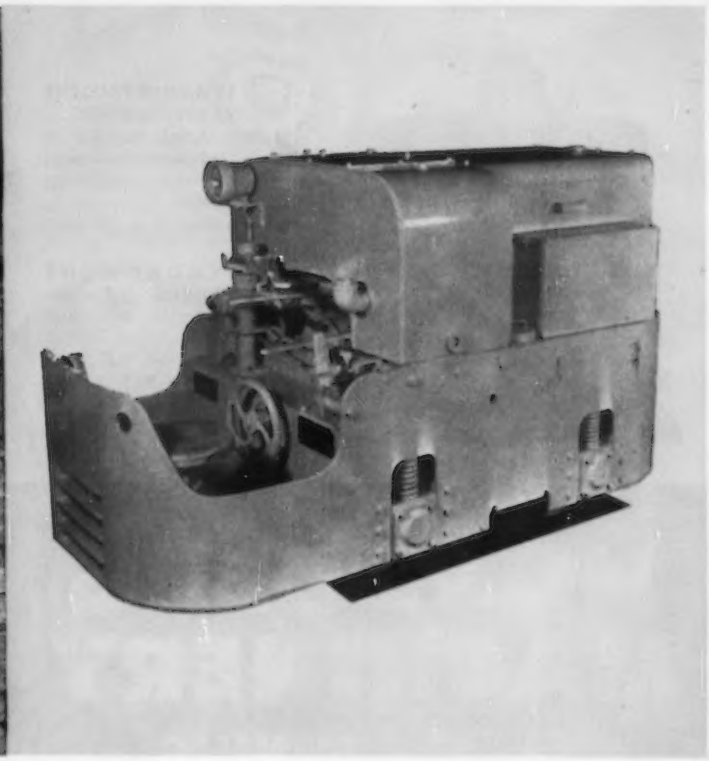
New York, N. Y. Chicago, Ill. San Francisco, Calif. El Paso, Tex. Birmingham, Ala. Duluth, Minn. Kellogg, Ida. Baltimore, Md. Pittsburgh, Pa. Seattle, Wash. Cleveland, Ohio Houston, Texas Vancouver, B. C. London, England Gateshead, England Paris, France Milan, Italy Johannesburg, South Africa

B-217

toughest

Royal Blue rope
is made of the *toughest*
rope wire ever developed...
Roebling Type 1105

John A. Roebling's Sons Corporation, Trenton 2, N. J., Subsidiary of The Colorado Fuel and Iron Corporation BRANCHES: ATLANTA, 934 AVON AVE. • BOSTON, 51 SLEEPER ST. • CHICAGO, 5525 W. ROOSEVELT RD. • CINCINNATI, 2340 GLENDALE MILFORD RD., EVENDALE • CLEVELAND, 13225 LAKEWOOD HEIGHTS BLVD. • DENVER, 4801 JACKSON ST. • DETROIT, 815 FISHER BLDG. • HOUSTON, 6216 NAVIGATION BLVD. • LOS ANGELES, 5340 E. HARBOR ST. • NEW YORK, 19 RECTOR ST. • ODESSA, TEXAS, 1920 E. 2ND ST. • PHILADELPHIA, 230 VINE ST. • PITTSBURGH, 1723 HENRY W. OLIVER BLDG. • SAN FRANCISCO, 1740 17TH ST. • SEATTLE, 900 1ST AVE. S. • TULSA, 321 N. CHEYENNE ST. • EXPORT SALES OFFICE, 19 RECTOR ST., NEW YORK 6.



Looking for a small, powerful diesel locomotive ?

When drifts are too narrow and crooked for a large locomotive . . . when a small storage battery unit lacks the power to keep loads moving profitably . . . you need Mancha's 2-Ton Diesel.

This small but powerful locomotive is only 47" high, 37" wide, and 88" long . . . but it will easily handle trailing loads requiring 1000 lb. drawbar pull on a 24 hour schedule. Low first cost, low maintenance cost, and low operating expense make it profitable for any mine considering diesel haulage.

Other important advantages of this locomotive include:

- Single speed transmission with gears always in mesh, no shifting.
- Hydraulic torque converter to balance engine output to drawbar pull requirements.
- Smooth acceleration, and ease of speed control by throttle lever.
- Rapid change of direction possible through simple transmission brake, jaw clutch operation.
- Two cylinder, four cycle engine of standard design.
- Effective exhaust scrubber.
- Convertible track gauge, 18" to 24".

All this adds up to lower hauling costs and greater profit. Write today for catalog M-113.

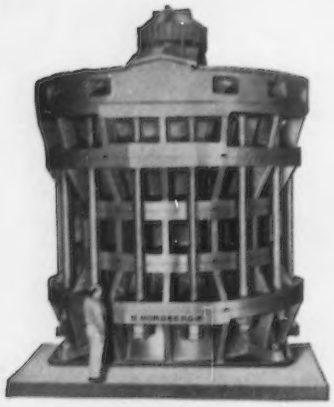
MANCHA

STORAGE BATTERY LOCOMOTIVE

DIVISION GOODMAN MANUFACTURING COMPANY

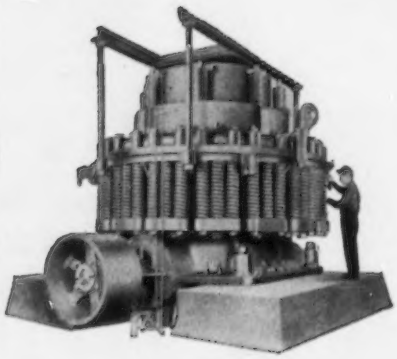
Halsted Street and 48th Place • Chicago 9, Illinois • Cable Address: Mancha, Chicago

Mancha representatives are located in principal mining areas throughout the world.



SYMONS® PRIMARY GYRATORY CRUSHERS... Built in sizes from 30" to 72" feed openings to meet any desired production operation.

SYMONS CONE CRUSHERS... The machines that revolutionized crushing practice. Built in sizes from 22" to 7' diameter heads with a wide range of capacity.



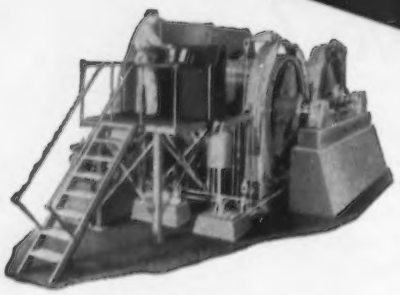
NORDBERG MACHINERY for the MINING INDUSTRY

For base metals...precious metals ...the rarer elements...non-metallics and minerals . . . NORDBERG MACHINERY is the outstanding choice of producers in the mining industry the world over.

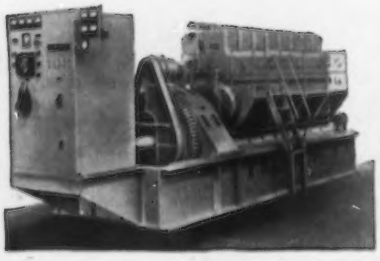
More than half a century of progressive engineering achievement, combined with quality production, in unexcelled manufacturing plants, have firmly established Nordberg's leading position in the field of heavy machinery design and construction.

Nordberg Machinery assures maximum and continuous production at low operating and maintenance cost. For full details, write for literature on the machinery you need.

NORDBERG MFG. CO.
Milwaukee, Wisconsin

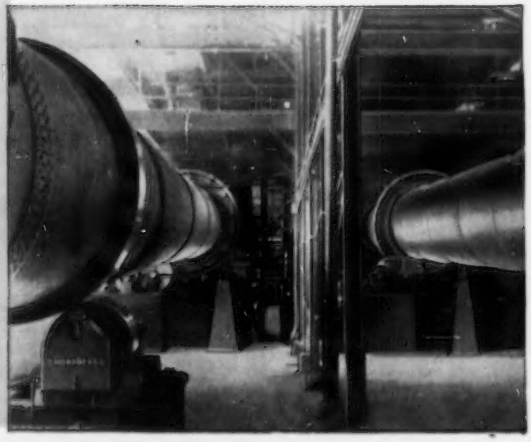


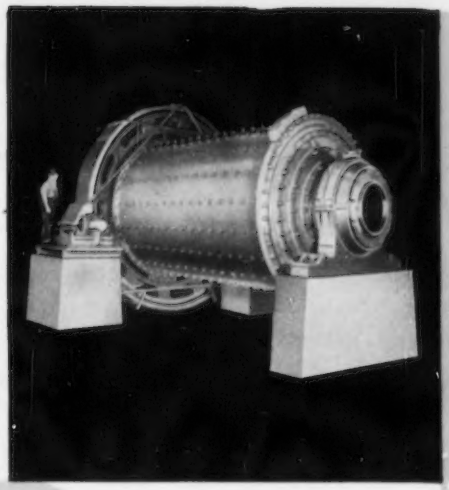
NORDBERG MINE HOISTS... As the source of the most progressive hoist engineering advances in the mining industry, Nordberg has held worldwide leadership in the hoist field since 1895.



NORDBERG ENGINES . . . For oil, gas or Duafuel® operation. Built in sizes from 10 to over 10,000 horsepower to meet practically all power requirements.

NORDBERG KILNS — DRYERS and COOLERS... To meet a wide range of requirements, including pyro processing operations, drying, calcining burning and cooling.





NORDBERG GRINDING MILLS . . . Ball, tube, rod and compartment types for wet or dry, open or closed circuit operation.

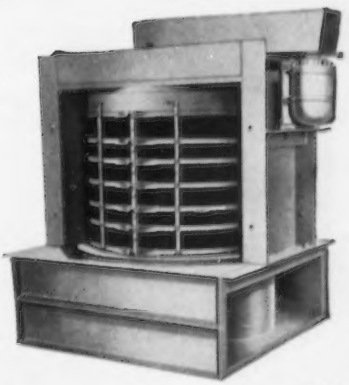
SYMONS VIBRATING GRIZZLIES . . . Built in bar and rod types for effective heavy duty scalping service handling feed sizes up to 30" and larger.

NORDBERG GYRADISC CRUSHER . . . A revolutionary machine for the production of large tonnages of extremely fine product.

SYMONS HORIZONTAL VIBRATING SCREENS . . . Level position assures extreme accuracy in sizing, requires less headroom, permits easy installation.

SYMONS ROD DECK SCREENS . . . Highly efficient screening surface of spring steel rods—easily replaced. Especially suited for wet, sticky materials.

SYMONS "V" SCREENS . . . For extremely fine, single cut wet or dry separations. Employs controlled diffused feed and vertical flow of material.



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M 155-R

NORDBERG MACHINERY

NORDBERG

MACHINERY FOR PROCESSING ORES and INDUSTRIAL MINERALS

NEW YORK • SAN FRANCISCO • DULUTH • WASHINGTON
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SYMONS . . .

A REGISTERED NORDBERG TRADEMARK KNOWN THROUGHOUT THE WORLD

HOW MARCY EXPERIENCE

WITH 2-STAGE GRINDING

Increases tonnage at lower cost

Mine and Smelter has specialized in the design, manufacture and application of Marcy Mills since 1915. The extensive research and experience during this time has resulted in many refinements in the grinding process. One of the most significant developments is 2-stage grinding.

Experience has proved two successful ways of using Marcy Open End Rod Mills for 2-stage grinding...

1. By addition of a grinding stage

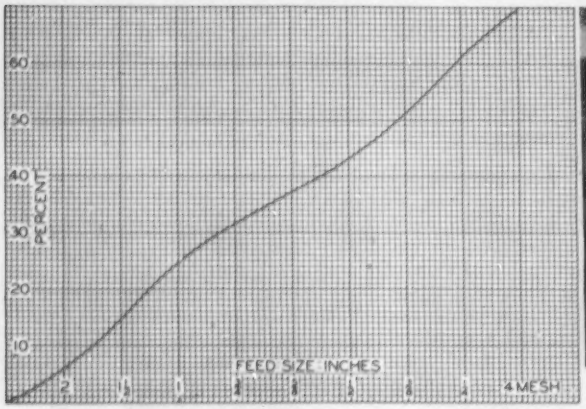
Adding Marcy Open End Rod Mills between existing crushing and grinding circuits...

- Permits larger size crusher discharge, thus greatly increases crushing capacity
- Rod mill can take 1" feed and produce a higher percentage of finished product than crusher
- Rod mill provides finer feed for ball mills, increasing their capacity
- Permits recovery of liberated mineral at coarser size

2. By replacing fine crushing

Replacing fine crushing with Marcy Open End Rod Mills gives all the advantages listed under No. 1, in addition to eliminating the high operating and maintenance costs of complex circuits of crushers, rolls, screens, elevators, etc.

Operating experience has proved that use of Marcy Open End Rod Mills for 2-stage grinding will increase tonnage at lower overall cost per ton



This graph shows increase in mill capacity with decrease in size of feed. For example if a rod mill was used to decrease ball mill feed from 1" to 4 mesh the ball mill capacity would be increased 45%.

This large copper company installed a 9½' x 12' Marcy Open End Rod Mill in parallel with its 2-stage roll-screen circuit. As a result of this test 17 Marcy Rod Mills were installed to replace all roll-screen circuits. Rod Mill feed is 1½" hard ore; grind is to 4% + 10 mesh; tonnage up to 2700 tons per day, each mill. They reduced costs and improved operating conditions.

The Mine & Smelter Supply Co.

DENVER • SALT LAKE CITY • EL PASO • NEW YORK

Representatives in Foreign Countries

FOR ACTUAL OPERATING DATA ON 2-STAGE GRINDING ← WRITE, WIRE OR CALL

Longyear

Longyear.... complete service to the mining industry

From advance reconnaissance to mine development... look to Longyear for complete service

DIAMOND CORE DRILLS

Research and development have put Longyear diamond core drills, equipment and supplies in demand by mining men everywhere. The Longyear Wire Line Core Barrel shown on this page is one example of Longyear's forward-looking policies in the development of drilling equipment.

CONTRACT DRILLING

High core recovery at minimum cost is the standard successfully maintained by efficient Longyear drill crews on the job. Exploratory drilling, foundation testing, soil sampling, and grout hole drilling are some of the services available to you through the Longyear Contract Drilling Division.

GEOLOGICAL, MINING CONSULTING

Longyear's full staff of geologists and mining engineers can provide you with professional assistance in every phase of your operation—from advance reconnaissance to mine development.

FOR MORE INFORMATION ABOUT LONGYEAR AND LONGYEAR SERVICES AND EQUIPMENT, *WRITE FOR* GENERAL BULLETIN #96.

Using the Longyear Wire Line Core Barrel, this drill crew is able to obtain excellent core samples *without* pulling the entire string of drill rods after each core run. This drilling tool is revolutionizing exploratory diamond core drilling.

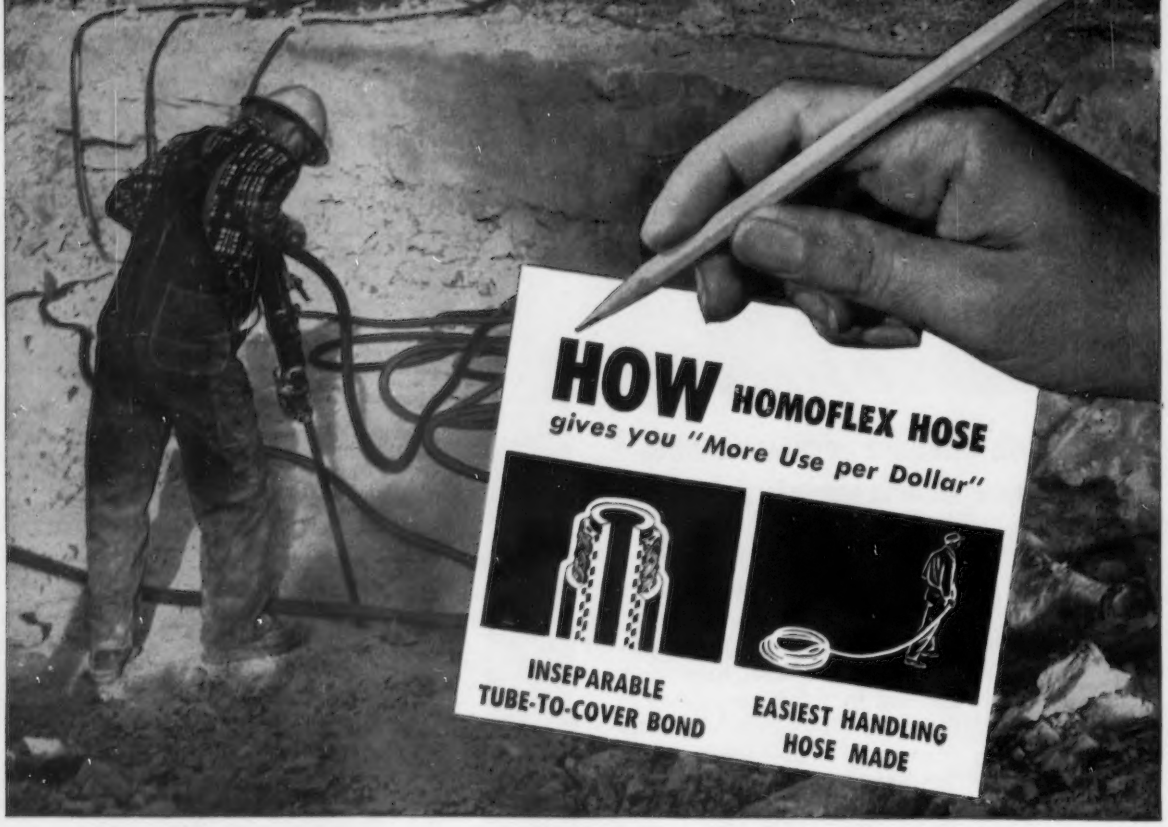
This Longyear contract drill team knows how to get good core samples with a minimum of time on the job. Highly trained Longyear crews using modern equipment are available for short or long-term drilling assignments in any part of the world.

These Longyear geologists are conducting a magnetometer survey. Longyear maintains a full staff of geologists and mining engineers to provide assistance as you require.

Diamond Core Drill Manufacturers
Core Drilling Contractors • Mining Engineering and Geological Consultants

E. J. LONGYEAR CO. CABLE LONGCO
General Offices: Foshay Tower
Minneapolis 2, Minnesota

CANADIAN LONGYEAR LTD., NORTH BAY, ONTARIO • LONGYEAR ET CIE., PARIS, FRANCE



This Easiest Handling Hose Gets More Work Done–Cuts Labor Costs

Bulk and stiffness have been engineered *out* of this modern hose. The unique construction of Homoflex Hose makes it light, flexible as a rope, yet strong. Made with no pre-set twist, it coils and uncoils *without* kinking. Exclusive R/M engineering creates a homogeneous cover, strength member and tube that are virtually inseparable . . . This hose is easier to handle, yet strong and safe for the toughest jobs!

Homoflex Hose is easier to couple, too, because it has uniform inside and outside diameters. All these features mean that Homoflex Hose lasts longer, gets more work done, handling air, water, other fluids and gases. Ask the R/M representative to show you how Homoflex Hose and other types of R/M hose for general and special purpose use do a better job, longer . . . give you "More Use per Dollar."

RM-61E

RM

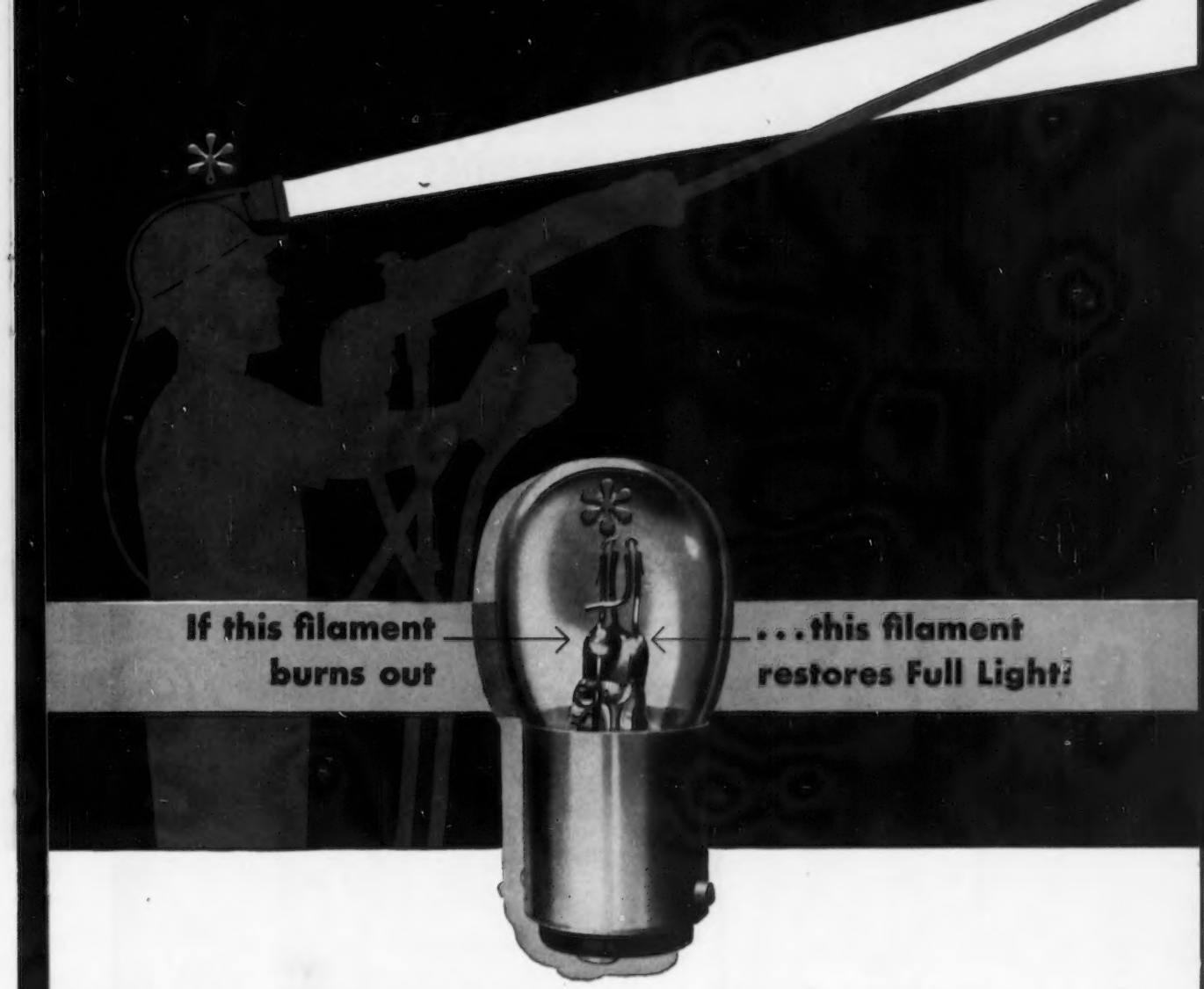
MANHATTAN RUBBER DIVISION—PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings
Asbestos Textiles • Packings • Engineered Plastic, and Sintered Metal Products • Laundry Pads and Covers • Bowling Balls

NEW

on heavy media



Man-hour protection for working crews . . . the Edison R-4 double-filament bulb

Working crews are assured greater underground safety, more productive man-hours because the Edison R-4 double-filament bulb is on the job.

Miners equipped with this bulb know that burn-out doesn't mean blackout. If one filament burns out, a turn of the switch transfers the power of the unfailing Edison battery to the second filament—continued, brilliant illumination is restored for the full shift. There's no lost time for the miner, or short crews for the foreman. There is only *one bulb*, located in the center of the headpiece, which gives the advantages of maximum reflector area.

This kind of reserve light protection means that hundreds of man-hours may be saved every year. The result is increased production with an added margin of safety. Our bulletin gives complete details. Write for your copy.

Edison R-4 Cap Lamp . . . ideal for self-service systems.

MSA
SAFETY EQUIPMENT HEADQUARTERS

When you have a safety problem, M-S-A is at your service . . . our job is to help you

MINE SAFETY APPLIANCES COMPANY
201 North Braddock Avenue, Pittsburgh 8, Pa.
At Your Service: 77 Branch Offices in the United States and Mexico

MINE SAFETY APPLIANCES CO. OF CANADA, LTD.
Toronto, Montreal, Calgary, Edmonton, Winnipeg, Vancouver, Sydney, N.S.

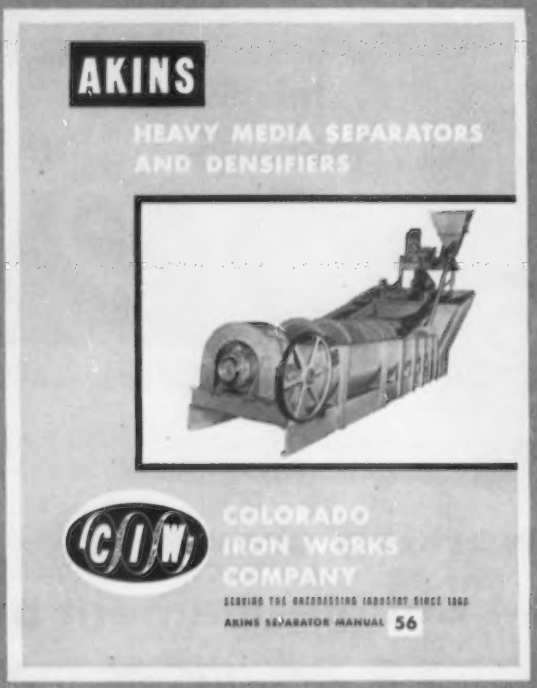
IN CALIFORNIA . . . AND THE WORLD OVER

Bucyrus-Erie Electric Shovels Cut Costs

NEW MANUAL on heavy media

SPIRAL SEPARATORS and DENSIFIERS

Experimentation on use of the Akins Spiral Classifier in making a sink and float separation was first started in 1938. In 1944 the first commercial 78" Akins Separator was placed in successful operation by one of the large iron mining companies. Since then there have been many developments and refinements, mechanically and metallurgically, in the Akins Separator and the HMS process. This new manual is a complete presentation of these developments and includes the latest data on heavy media spiral separators and densifiers...



- development of spiral HMS separators
- discussion of metallurgical and mechanical operation of spiral separators
- handling of middlings
- how the Akins makes a 3-product separation with one medium circuit
- operating data showing actual results
- purpose of the densifier and how it works
- flowsheets
- capacities and engineering data on Akins Separators and Densifiers
- operating and control instructions

PILOT PLANT TESTING SERVICE AVAILABLE
CIW has a 12" Akins Separator at the Colorado School of Mines Research Foundation which is available for conducting pilot tests.

For a copy of MANUAL 56 just write to...

Akins—the ORIGINAL spiral type classifier.

COLORADO IRON WORKS CO.

1624 17th Street • Denver 2, Colorado

AKINS CLASSIFIERS • SKINNER ROASTERS • LOWDEN DRYERS

Sales Agents and Licensed Manufacturers in Foreign Countries

A SUBSIDIARY OF THE MINE & SMELTER SUPPLY CO.

IN CALIFORNIA . . . AND THE WORLD OVER

Bucyrus-Erie Electric Shovels Cut Costs where they start . . . in the pit

A Bucyrus-Erie 6-cu. yd. 150-B is shown here removing overburden in a California open pit iron mine.

Big-output capacity plus month-after-month dependability are advantages that enable Bucyrus-Erie electric shovels to help hold down costs. In busy iron mines everywhere, these machines are helping owners cut costs with such outstanding advantages as:

1. Modern front-end design that combines light weight with great strength.
2. Sturdy construction, from boom point to treads, that saves maintenance and adds to life.
3. Ward Leonard variable-voltage control which permits rapid acceleration and deceleration and assures plenty of extra torque and power when it's needed.

Follow the lead of successful owners the world over — put a Bucyrus-Erie electric shovel to work keeping output high and costs low. You can choose from three models — the 4½-yd. 110-B, the 6-yd. 150-B, and the 8-yd. 190-B.

83L56C

GLOBAL APPROVAL
MOROCCO · PHILIPPINES · RHODESIA · UNITED STATES · VENEZUELA · ALGERIA · CANADA · CONGO · ENGLAND · FINLAND · FRANCE · INDO-CHINA
110-B 4½-cu. yd.
150-B . . 6-cu. yd.
190-B . . 8-cu. yd.
BUCYRUS ERIE

BUCYRUS-ERIE COMPANY SOUTH MILWAUKEE, WISCONSIN

The NEW LIDDICOAT TEE CEE Bit

(Patents applied for)

is "drilled to destruction without resharpening"

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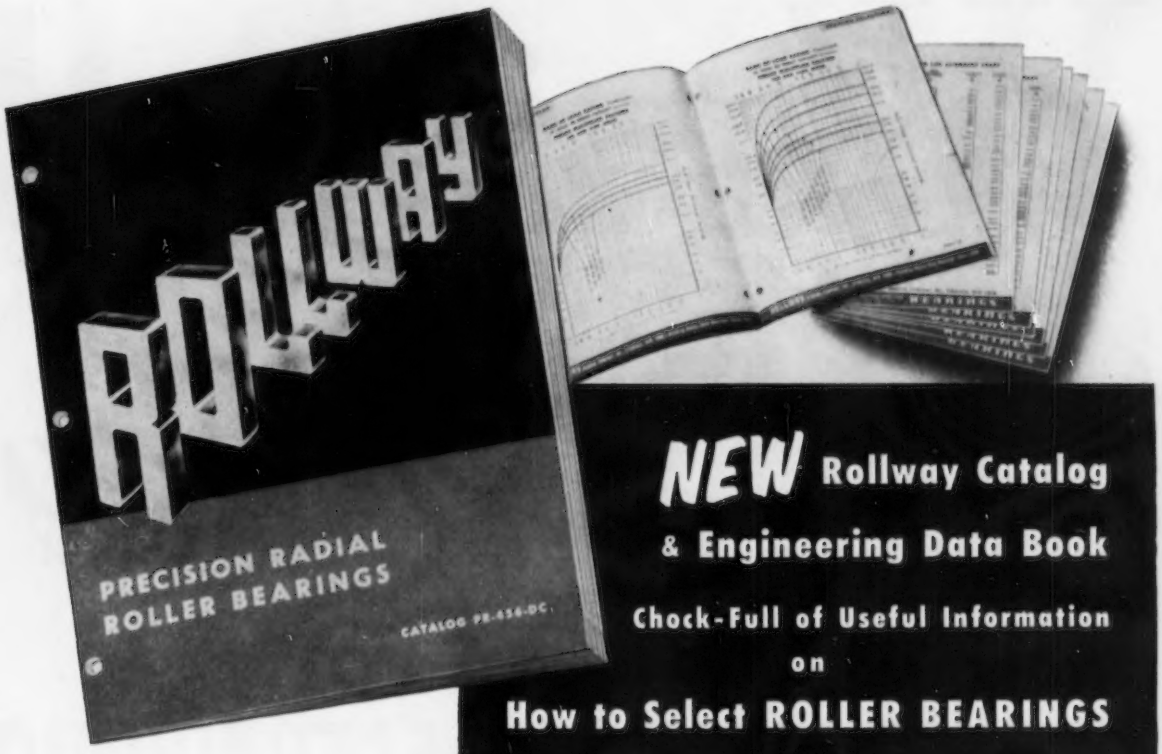

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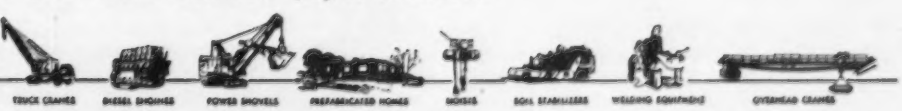

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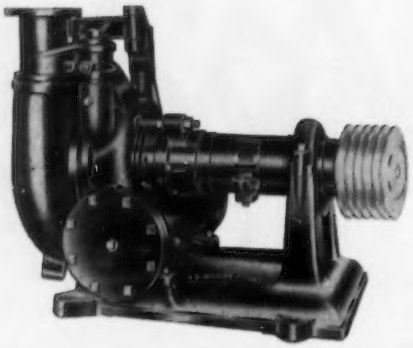

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ENGINEERING AND MINING JOURNAL

OCTOBER 1956

New Look in Metal Economics

MORE AND MORE YOU FIND an emphasis on the assurance of future supply creeping into the pronouncements by nonferrous metal producers.

In some quarters, these "we've-got-plenty" announcements are merely talk: At best a whistling in the dark; at worst a gambit to discourage competition from other metals, other companies or other countries. None of us can sit on judgment of this policy but in an era of an expanding economy it seems like a crippling conservatism.

Far healthier seems the attitude of those who consider an adequate supply of metal to be a basic tenet of business philosophy. Mr. Langbourne Williams, president of Freeport Sulphur and author of the article on nickel in this issue (p. 75), expresses this spirit in a blunt statement on the nickel situation; "It's more important to have a good supply than low prices."

Mr. Williams points out that with a nickel supply assured, more people will "design toward nickel" and all producers will do more business in an expanding market. This is Point 1.

Another aspect of this accent on supply was spelled out last March by Richard Reynolds Jr., president of Reynolds Metals, when he announced a 1½c price rise in aluminum.

"This increase in price has long been necessary," said Mr. Reynolds, "to assure our customers the expanded aluminum supplies required to meet their growing demands. . . .

"The capital requirements of primary aluminum plants, are extraordinarily large. Such new facilities, from the ore to the pig stage, today cost about $1,500 per ton of capacity. This is five times the capital required per ton of integrated steel capacity. To create new capacity, aluminum producers must therefore be able to attract large blocks of new capital.

"The task of financing new capacity has become increasingly difficult because aluminum prices have lagged far behind the cost of new plants, the prices for the materials used in the production of aluminum, and the rise in freight rates.

"By making it possible to increase the supply of aluminum more rapidly and more substantially, this price increase is the most effective long-range safeguard of a relatively low price for aluminum products far into the future. Nothing is more effective in keeping prices low than a supply adequate to the demand."

Point 2: Assuring a supply of metal is the best safeguard against inflation. A small price rise now, to attract expansion capital, can prevent runaway prices in a shortage ridden future.

It would be somewhat unsophisticated to credit this general approach to the metal supply situation to purely altruistic motives—the prevention of inflation. It's just good sound business which in the long run will reward the company on the profit side of the balance sheet. It means that metal customers will face less of a problem of threading their way through alternate periods of plethora and scarcity with the concomitant drastic fluctuations in price.

It would be equally naive to assume that any metal company could at any time indulge in this philosophy. One of the essentials is an expanding economy.

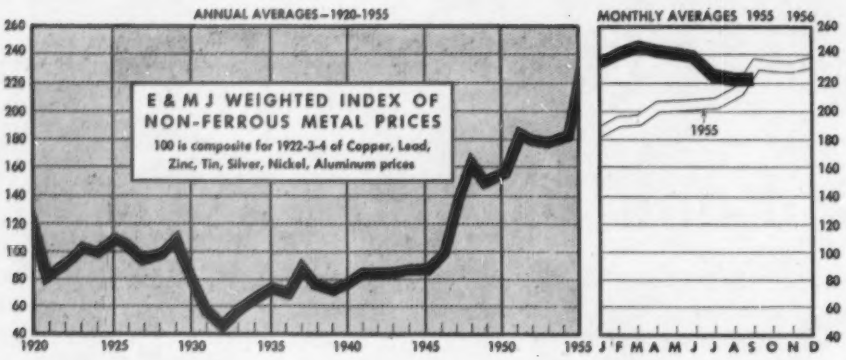
There are also a number of metals whose economic situations have been pretty well established by their past histories—industries who reached the point decision years ago and decided upon today's profit rather than tomorrow's growth. In all fairness, it should be pointed out that these industries didn't face the happy raw materials status of the aluminum industry nor the obvious growth possibilities of nickel but nevertheless a bearish choice was made.

The question before the house becomes: Is it too late to establish a firmer metal economy by shift-emphasis to assuring consumers of a future supply at fairly steady prices. For example suppose the copper price were established at 30c a lb, a price at which 90% of the producers could make a profit. Would this establish a base from which copper companies could start their own expansion in gear with the expanding economy? As the market seemed ready to absorb more copper could not price be raised to finance expansion that kept in step with consumers' needs?

We well realize the complications in this particular example—the role of copper in Chilean economy, the lack of control over copper supplies, the relative difficulty of copper ore supply as compared to aluminum. But as a general philosophy in an expanding economy, we feel that emphasis in future supply can pay real dividends to the metal producers of the Free World.

E&MJ OUTLOOK

PRICES



MARKETS

Thanks to slight gains in aluminum, tin and silver, *E&MJ's* metal price index showed a slight gain (to 227.42) after dropping two months running.

Many manufacturers will go slow on 4th quarter steel, aluminum, and copper purchases. They feel stocks are too high and the metals are readily available. But nickel continues to be scarce.

U. S. may agree to gold price rise "before many years have passed" says Lombard in London's *Financial Times*. Reasons: U. S. is now a net seller of gold, her obligations to foreign countries are nearing the gold stock figure.

Experts figure copper scrap firms will be helped the most by Government's liberalization of export restrictions. More refined copper will go abroad, too, but prices there will continue lower than in the U. S.

Aluminum scrap export curbs may be lifted despite smelters' complaint that shortage exists here. Dealers say smelters won't buy grades saleable abroad.

LABOR

Increased safety legislation for non-ferrous mines in the upcoming 85th Congress could result from testimony by Mine-Mill officials. Stronger welfare arrangements are in the offing too.

AT HOME

New Mexico will move up to top U. S. uranium producer when next industry figures are released. The surge ahead of Utah is due mainly to stepped-up pace at Anaconda's Jackpile and Rio de Oro's Ambrosia Lake mines plus two new mills.

Mica Miners are having troubles. Despite price rise last May, stricter interpretation of buying specifications results in production bringing less than it did last Spring.

Is the military aircraft industry out as future titanium market? Some experts say that with contemplated aircraft and missile speeds, the jump in surface temperatures generated will require stainless steel skins. Titanium would only permit about 50°F more surface temperature than aluminum.

ABROAD

Platinum group metals use is on upswing—imports were 1-million oz last year compared to 600,000 in 1954.

Non-ferrous metals continue to get Iron Curtain emphasis as Bulgaria plans to modernize its lead-zinc mines and to hasten work on new processing plant in Tshiprovtsi.

Fabulous New Brunswick will look even more fabulous when several large U. S. companies report their newest finds.

Rumors say Bethlehem Steel will buy world's oldest gold mine in Brazil.

September Copper Activity Improved But Still Well Below Last Winter

ECONOMIC ACTIVITY in September was probably at about the same level as in August. Automobile production failed to rise as much as had been expected. The Federal Reserve Board seasonally adjusted index of industrial production in August was 141% of the 1947-49 average and *E&MJ* estimates the index at the same level for September.

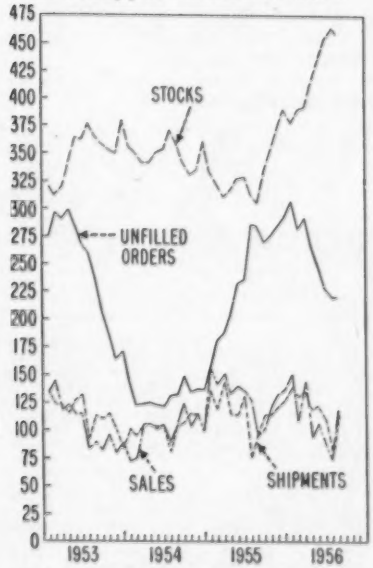
Nonferrous metal prices in September rose for the first time since March 1956. This month they went up to 227.42% of the 1922-24 average from 226.85% in August. The price of copper continued to fall but increases in silver, tin and aluminum more than offset it. Since March of this year copper prices each month had fallen enough to dominate the index.

Sales of refined copper in September were a little better than during the summer but still well under the past winter and spring. Daily average pricings of copper reported to *E&MJ* rose to about 85% of the March-April average. This base period is arbitrary and is not assumed to be normal. The June pricings were about 84%, July about 65%, and August about 70%. September had fewer business days than most months; on a monthly average rather than daily average basis the average would be lower than 85%.

Copper Institute data for August show deliveries of refined copper to customers in the U. S. to be 110,128 short tons; July was 97,698 tons. The average for the first six months of 1956 was 136,750 tons. Many persons in the copper industries regarded August business with considerable disappointment—they had expected a recovery to levels much closer to those early in the year. Shipments of products by fabricators in August improved. They were 117,937 short tons; July was 81,275 tons. The first quarter figure for this year was about 135,000 tons. Sales also during the first quarter averaged about 135,000 tons and the August figure was 119,102 tons. Sales vary greatly from month to month. In January 1956 they were about 151,000 tons, in February they dropped to 107,000 tons and in March they rose to about 145,000 tons.

The disappointment among copper firms in August was repeated in September. Though some pick-up was evident copper fabricators are now talking of October as the month when an increase will be felt. Probably too much attention is being focused on the automobile industry in this connection. In a recent speech Roy H. Glover, chairman of the Anaconda Co., pointed out that in the U. S. about 8% of the copper consumed by industry went into automobiles. The difference between a good and bad year in the auto manufacturing industry is likely to mean only a few percentage points difference in the use of copper. The difficulty arises when a number of industries have a bad period at the same time. This appears to be happening now. Some analysts though point out it is not so much that they are "bad" but that we have become accustomed to think of the maximum ever reached as normal—the past fall and winter were actually abnormally high as far as use of copper is concerned.

U. S. Copper Fabricator Data



Data, through August, in thousands of short tons, from the U. S. Copper Association.

Pricings of copper of foreign origin reported to *E&MJ* were good during September. Most persons familiar with the European copper situation claim this was scare buying brought on by the African strikes. Business in Europe, though it appears to have improved somewhat, is still below levels of last winter.

Copper prices in Europe weakened as the African strikes ended. London dropped to about 36¼c bid for prompt copper.

Copper Institute data for July and August 1956 follow:

United States

	July	Aug.
Production:		
Crude, primary	(a) 84,787	90,858
Crude, secondary	(a) 10,387	9,511
Totals	(a) 95,174	100,369
Refined copper	125,401	122,108
Deliveries, refined	97,698	110,128
Stock at end, ref'd	87,944	96,450

Outside United States

Production:		
Crude, primary	(a) 148,395	149,530
Crude, secondary	787	460
Totals	(a) 149,182	149,990
Refined copper	115,232	120,211
Deliveries, refined	101,102	114,762
Stock at end, ref'd	215,281	218,793

(a) Corrected figures.

The threat of strikes at the Garfield smelter and refinery was ended by a three-year agreement between the union and the two companies. Copper output in Chile by Anaconda and Kennecott in August reached an all time record of 40,100 metric tons.

Aluminum markets are not as strong as earlier in the year. Probably secondary aluminum has been much easier. Much secondary goes into the auto industry for die-casting. Home appliances have been taking less metal than had been expected. Primary production dropped to 92,406 tons in the U. S. in August owing to strikes. In September it will probably get back to the July level of about 151,624 tons.

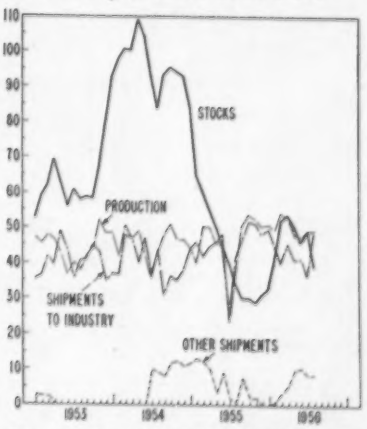
Zinc sales in the last week of September were unusually heavy. In part this reflects low sales earlier in the month. For the month they were probably no heavier than for August but they were much better than for July. GSA again came into the market for domestic zinc and lead—some firms did not offer. Some persons are beginning to ask if the program will be maintained much longer.

Lead sales the last full week of September, as reported to *E&MJ*, were the highest for any week of this year. July reports of sales to *E&MJ* were heavy, suggesting the good level of shipments in August reported by the American Bureau of Metal Statistics. September sales reported were also good, suggesting shipments this month or next may also be high. Lead, unlike zinc and copper, has held up well during the summer.

Tin prices remain high owing to continued uncertainty in the Suez situation. But the difficulty there has eased somewhat letting prices fall a little. Consumption by industry here continues in good quantity.

Quicksilver prices remained at $255-$257 per flask throughout the month.

Primary Refined Lead Data



Data, through August, in thousands of short tons, from the American Bureau of Metal Statistics. "Other Shipments" apparently refers to shipments to the U. S. Government.

MARKETS *(Continued)*

Average Prices September (E&MJ Quotations)

Copper:	
Electrolytic, domestic refinery	39.597
Electrolytic, export refinery	37.511
Lead:	
Common, New York	16.000
Common, St. Louis	15.800
Silver and sterling exchange:	
Silver, New York, per oz.	90.750
Silver, London, pence per oz.	78.869
Sterling Exchange, "Checks"	278.304
Zinc:	
Prime Western, East St. Louis	13.500
Prime Western, delivered (g)	14.000
Tin:	
New York Straits	103.734
Gold, per oz. U. S. price	$ 35.000
Quicksilver, per flask	255.000
Antimony (E&MJ) (d)	36.470
Antimony, bulk, Laredo	33.000
Antimony, in cases, Laredo	33.500
Platinum, refined, per oz.	$104.000
Cadmium (a)	170.000
Cadmium (b)	170.000
Cadmium (c)	170.000
Aluminum, 99% plus ingot	27.100
Magnesium, ingot	35.250
Nickel (f)	64.500

Domestic quotations, unless otherwise stated, are in cents per pound. Sterling exchange checks, in cents. Quicksilver, per flask of 76 lb.

(a) Cadmium average based on the producers' quotations.

(b) Cadmium average based on the average of the producers' and platers' quotation.

(c) Cadmium average based on platers' quotation.

(d) Domestic, 5 tons or more but less than carload lots, packed in case f.o.b. New York.

(e) Tin content.

(f) F.o.b. Port Colborne, U.S. duty included.

(g) Delivered where freight exceeds 0.5c.

"Free" Gold Market

International transactions rose in September. The uneasy Suez situation dominated gold markets. Interest centered on coin trading especially in Near and Far Eastern markets. Dealings in bars took place on a limited scale. There were no Soviet gold sales reported. Pick's World Currency Report quotes on "free gold" per fine oz as follows:

	COINS		BARS (12.5 kg)	
	Aug. 31	Sept. 30	Aug. 31	Sept. 30
NEW YORK, transit	.....	.....	$35.08	$35.08
MANILA	$43.75	$43.75	36.10	36.15
HONG KONG	42.15	42.25	38.10	37.90
BOMBAY	56.25	56.50	54.25	55.10
TANGIER	41.75	40.75	34.95	35.04
BEYROUTH	44.00	44.40	35.20	35.18
PARIS	44.80	44.25	36.20	36.25
BUENOS AIRES	40.75	41.20	36.10	35.90

Note: Prices are quoted at the free or black market value of the U. S. dollar in the local markets.

Major Metals

U. S. DAILY AND AVERAGE PRICES

Sept. 1956	Electrolytic Copper (a) Domestic	(b) Export	Lead New York	Lead St. Louis	Zinc (f) Delivered	Zinc East St. Louis	Aluminum Primary Pig 99%	Straits Tin New York
1	No Market	37.400	16.000	15.800	14.000	13.500	25.000	100.125
3	Holiday	37.700	Holiday					
4	39.600	37.725	16.000	15.800	14.000	13.500	25.000	100.125
5	39.650	38.150	16.000	15.800	14.000	13.500	25.000	100.375
6	39.625	38.100	16.000	15.800	14.000	13.500	25.000	100.500
7	39.650	37.750	16.000	15.800	14.000	13.500	25.000	100.625
8	No Market	37.750	16.000	15.800	14.000	13.500	25.000	100.625
10	39.550	37.850	16.000	15.800	14.000	13.500	25.000	101.250
11	39.550	38.025	16.000	15.800	14.000	13.500	25.000	101.625
12	39.575	37.900	16.000	15.800	14.000	13.500	25.000	104.250
13	39.350	37.975	16.000	15.800	14.000	13.500	25.000	107.000
14	39.475	38.100	16.000	15.800	14.000	13.500	25.000	107.875
15	No Market	38.100	16.000	15.800	14.000	13.500	25.000	107.875
17	39.550	38.000	16.000	15.800	14.000	13.500	25.000	106.750
18	39.575	37.375	16.000	15.800	14.000	13.500	25.000	106.375
19	39.600	37.125	16.000	15.800	14.000	13.500	25.000	105.625
20	39.675	36.825	16.000	15.800	14.000	13.500	25.000	106.000
21	39.625	37.450	16.000	15.800	14.000	13.500	25.000	105.000
22	No Market	37.450	16.000	15.800	14.000	13.500	25.000	105.000
24	39.650	37.300	16.000	15.800	14.000	13.500	25.000	105.000
25	39.675	37.275	16.000	15.800	14.000	13.500	25.000	104.250
26	39.600	36.925	16.000	15.800	14.000	13.500	25.000	103.500
27	39.700	36.325	16.000	15.800	14.000	13.500	25.000	102.875
28	39.675	36.600	16.000	15.800	14.000	13.500	25.000	103.500
29	No Market	36.600	16.000	15.800	14.000	13.500	25.000	103.500
AVERAGES FOR MONTH								
Sept.	39.597	37.511	16.000	15.800	14.000	13.500	25.000	103.734
AVERAGES FOR WEEK								
Sept. 5	39.644	37.588	16.000	15.800	14.000	13.500	25.000	100.175
12	39.590	37.896	16.000	15.800	14.000	13.500	25.000	101.479
19	39.510	37.779	16.000	15.800	14.000	13.500	25.000	106.917
26	39.645	37.204	16.000	15.809	14.000	13.500	25.000	104.792
CALENDAR WEEK AVERAGES								
Sept. 1	39.655	37.467	16.000	15.800	14.000	13.500	25.000	99.708
8	39.631	37.863	16.000	15.800	14.000	13.500	25.000	100.450
15	39.500	37.992	16.000	15.800	14.000	13.500	25.000	104.979
22	39.605	37.371	16.000	15.800	14.000	13.500	25.000	105.792
29	39.660	36.838	16.000	15.800	14.000	13.500	25.000	103.771

Silver, Gold and Sterling

DAILY AND AVERAGE PRICES

Sept. 1956	Silver (c) New York	Silver London	Sterling Exchange "Checks"	Gold London	Gold (d) United States
1	(e)	(e)	(e)	(e)	$35.00
3	Holiday	78.750d.	Holiday	251s. 5½d.	Holiday
4	90.750	78.750d.	278.2500	251s. 5½d.	35.00
5	90.750	78.750d.	278.2589	251s. 5¾d.	35.00
6	90.750	78.750d.	278.2812	251s. 5¾d.	35.00
7	90.750	78.750d.	278.2366	251s. 5¾d.	35.00
8	(e)	(e)	(e)	(e)	35.00
10	90.750	78.750d.	278.2812	251s. 7½d.	35.00
11	90.750	78.750d.	278.3526	251s. 7d.	35.00
12	90.750	78.750d.	278.2857	251s. 6¾d.	35.00
13	90.750	78.750d.	278.2410	251s. 7¼d.	35.00
14	90.750	78.750d.	278.2500	251s. 7½d.	35.00
15	(e)	(e)	(e)	(e)	35.00
17	90.750	78.750d.	278.3125	251s. 7¼d.	35.00
18	90.750	78.750d.	278.3750	251s. 7½d.	35.00
19	90.750	78.750d.	278.3750	251s. 6¾d.	35.00
20	90.750	78.750d.	278.3437	251s. 7¼d.	35.00
21	90.750	78.750d.	278.3437	251s. 7d.	35.00
22	(e)	(e)	(e)	(e)	35.00
24	90.750	78.750	278.3750	251s. 7d.	35.00
25	90.750	79.125	278.3794	251s. 7d.	35.00
26	90.750	79.500	278.3437	251s. 7½d.	35.00
27	90.750	79.375	278.2500	251s. 8¼d.	35.00
28	90.750	79.375	278.2321	251s. 8d.	35.00
29	(e)	(e)	(e)	(e)	35.00
AVERAGES FOR MONTH					
Sept.	90.750	78.869	278.304	—	35.00
AVERAGES FOR WEEK					
Sept. 5	90.750	—	278.252	—	35.00
12	90.750	—	278.287	—	35.00
19	90.750	—	278.311	—	35.00
26	90.750	—	278.357	—	35.00

Calendar Week Averages: New York Silver: Sept. 1st, 90.750; 8th, 90.750; 15th, 90.750; 22nd, 90.750; 29th, 90.750.

(e) No Market (Saturday).

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis. All prices, except gold or silver, are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.300c per pound, the average differential for delivery charges.

(b) Our export quotations for copper reflects prices obtaining in the open market and is based on sales in the foreign market reduced to the f.o.b. refinery equivalent, Atlantic seaboard. On f.a.s. transactions we deduct 0.075c for lighterage, etc., to arrive at the f.o.b. refinery quotations.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingots; cathodes are sold at a discount of 0.125c to 0.15c per pound. Quotations for zinc are based on Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East, Middle West, and West, effective Jan. 1, 1951, commanded a premium of 1.35c per pound over the current market for Prime Western; Special High Grade 1.75c effective Dec. 1, 1955.

(f) Prime Western delivered where freight from E. St. Louis exceeds one-half cent.

Quotations for lead are based on domestic common lead. Corroding lead commands a premium of 10 pounds.

(c) The daily silver quotation reported by Handy & Harman, in cents and fractions of a cent per troy ounce, is the price paid by Handy & Harman in settlement for silver contained in unrefined silver-bearing materials submitted to them for refining. It is determined on the basis of offers of bar silver .999 fine as made to Handy & Harman for nearby delivery at New York by regular suppliers in quantities sufficient to meet daily requirements, and it is usually one quarter cent below the price at which such offers are made.

The treasury's purchase price of newly mined domestic silver is 90.5 per troy ounce 1000 fine effective July 1, 1946. London silver in pence per troy ounce, basis .999 fine.

(d) U.S. Treasury's gold price. Actual payment by the United States Treasury for gold is at 99.75 per cent of the price quoted by the Treasury, which is equal to $34.9125.

London Metal Exchange Quotations

Sept.	COPPER Cash Bid	Cash Asked	3 Mo. Bid	3 Mo. Asked	LEAD Current Month Bid	Current Month Asked	3 Mo. Bid	3 Mo. Asked	ZINC Current Month Bid	Current Month Asked	3 Mo. Bid	3 Mo. Asked	TIN Cash Bid	Cash Asked	3 Mo. Bid	3 Mo. Asked
3	304½	305½	304	304½	116	116¼	114¼	114½	95½	95¾	93½	93¾	766	767	764	765
4	304	304½	304	304½	116½	117	114¾	115	95¾	96½	93½	94	771	772	767	768
5	309	309½	308	309	116¾	117	114¾	115	96¼	96½	94¼	94½	771	772	767½	768
6	307½	308	307	307½	116¾	117	115	115¼	95¾	96	94	94¼	772	773	768	768½
7	303½	304	303	303½	116¾	117	115	115¼	95¾	96¼	94	94¼	772	773	769	769½
10	307	308	306½	307	117½	117¾	115½	115¾	96	96½	94	94½	777	778	772	772½
11	307	307½	306	307	118½	118½	115¾	116	96¼	96½	94¼	94½	782	783	777	778
12	307	307½	306	306½	118½	118¾	116	116¼	96¼	96½	94¼	94½	793	794	785	786
13	309	309½	308½	309	118¾	119	116¼	116½	97	97¼	94¾	95	807	808	799	800
14	313	313½	311	312	118	118½	116	116¼	96¾	97½	94½	95	827	828	815	817½
17	309½	310½	308	309	118	118½	116	116¼	96	96½	94	94¼	810	812½	802½	805
18	304	304½	302½	303¼	117	117½	115	115½	96	96½	94	94½	801	802	791	792
19	295	296	294	294½	116¼	116¾	114½	114¾	95½	96	93¾	94	789	791	779	781
20	296½	297½	295½	296	116¾	117	114¾	115	96	96½	94¼	94½	794	795	784	785
21	298	298½	296½	297	116¾	117	114¾	115	96¾	97	94½	94¾	798	799	786	787
24	299	299½	298	299	117	117¼	115	115¼	96¾	97¼	94½	95	797	798	784	786
25	298½	299	297½	298	116¾	117	114¾	115	96½	96¾	94½	94½	794	795	781	782
26	292	293	291	292	116	116½	114¼	114½	96½	97	94¼	94½	783	784	770	772
27	292	292½	291	292	116½	116¾	114¼	114½	96¼	96½	94¼	94½	780	782½	767½	769
28	291	292	291	292	115¾	116	113¾	114	95¾	96¼	94	94½	782	784	768	770
Av'g's	£302.688		£301.813		£117.175		£115.144		£96.344		£94.288		£788.925		£780.463	

Prices are for the official a.m. session in pounds sterling per ton of 2240 lb. Copper basis wire bars, lead 99.97%, zinc 98¾ and tin min. 99.75%.

Miscellaneous Metals, Ores, Minerals

Quotations cover wholesale lots, prompt shipments f.o.b. New York unless otherwise stated, tons of 2,000 lb unless otherwise noted, St—short ton, lt—long ton.

MISCELLANEOUS METALS

Sept. 28, 1956

Aluminum ingot, 99 plus % lb			27.1¢
Antimony, spot, lb. less than carload, in cases			36.47¢
In bulk, carload lots, f.o.b. Laredo			33.00¢
Bismuth, ton lots, lb			$2.25
Cadmium, commercial sticks, delivered, lb			$1.70
Calcium, lb, ton lots, 98%, cast			$2.05
Chromium, 97% grade, lb, contract			$1.25
Cobalt, 97 to 99%, per lb			$2.60
Germanium, per gram, 10,000 gram lots	44½¢	@	48½¢
Indium, troy oz			$2.25
Lithium, lb, 98%	$11.00	@	$14.00
Nickel, cathodes, lb, f.o.b. Port Colborne (a)			64½¢
Magnesium, 99.8%, carloads, lb, producer's plants, Velasco, Texas, Eff, Apr. 16			35½¢
Palladium, troy oz	$23.00	@	$24.00
Platinum (wholesale lots) troy oz	$103	@	$108
Quicksilver, flask of 76 lb, 25 flasks or more	$255	@	$257
Selenium, 99 plus %, lb. (Feb. 1)			$13.50
Silicon, minimum 97%, carloads, lb			20½¢
Tellurium, lb	$1.50	@	$1.75
Thallium, 100 lb or more, lb			$12.50
Titanium, 99.3 plus, grade A-1, max. 3% iron, lb			(b)$3.00

(a) Includes U. S. duty. (b) Effective July 2 and July 9, 1956.

METALLIC ORES

Beryllium Ore, imported, 10% BeO, per short ton unit	$36.00	@	$38.00
Chrome Ore per long ton, f.o.b. cars Atl. ports, dry:			
44% Cr_2O_3 no ratio	$25.50	@	$27.00
48% Cr_2O_3 3 to 1 ratio	$55	@	$59.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:			
Old Range bessemer			$11.25
Mesabi bessemer			$11.00
Mesabi, non-bessemer			$10.85
Lead (Galena), 80%, Joplin, Mo., ton			$201.32

Manganese Ore—Per long ton unit of Mn basis 48% manganese, nearby positions, subject to premiums and penalties $1.45 @ $1.50 c.i.f. U. S. ports, import and export duties extra. Long-term contract nominal.

Molybdenum Ore, 90%, per lb of Mo f.o.b. mines	$1.18	@	$1.23
Columbium-Tantalum, per lb, combined oxides 10 to 1 ratio	$1.35	@	$1.50
Tungsten Ore, per unit of WO_3:			
Foreign 60%, c.i.f. U. S. ports, duty extra	$30.50	@	$31.00
Domestic, scheelite, 60% f.o.b. mill (gov't price)			$55
Vanadium Ore, per lb of contained V_2O_5 f.o.b. mines			31¢
Zinc Ore, Prime, 60% concentrate, Joplin, Mo., per ton			$84.00

(a) Nominal. (b) Corrected.

METALLIC COMPOUNDS

Arsenous Oxide (arsenic trioxide) lb, in bbl carload lots delivered			5½¢
Cobalt Oxide, 72¼% to 73¼%, ceramic grade, per lb	$1.96	@	$1.98½
Copper Sulphate, 100 lb			(a)$15.20
Germanium Oxide, gram			27½¢
Molybdic trioxide, technical, per lb of Mo	$1.30	@	$1.33

ALLOYS

Ferrochrome 65 to 70%, per lb of Cr. (4-9% C)			27½¢
Ferromanganese, 74 to 76%, per lb., shipg. pt	10¾¢	@	11½¢
Ferromolybdenum, 58 to 64% Mo, lb of Mo contained	$1.68	@	$1.74
Ferrosilicon, 50% per lb of Si f.o.b. shipping point			13½¢
Ferrotungsten, 72 to 82%, lb of W contained (eff. Feb. 1)			$3.45
Ferrovanadium, per lb of V delivered	$3.20	@	$3.40
Silicomanganese, max. 1½% carbon, lb, contracts			12.95¢
Spiegeleisen, per long ton, 19 @ 21% grade			$96.00

(a) Eff. July 10, 1956.

NON-METALLIC MINERALS

Asbestos, f.o.b. Canada (Quebec) mines (U. S. funds) ton:			
Crude No. 1	$1,400	@	$1,725
Crude No. 2	$750	@	$1,100
Spinning fibers	$350	@	$650
Shingle fibers	$190	@	$210
Paper stock	$114	@	$137
Waste	$82	@	$84
Shorts	$28	@	$75
Asbestos, f.o.b., Vancouver, B. C. (U. S. funds):			
Spinning fiber	$460	@	$750
Shingle fiber, effective Jan. 1	$205	@	$300
Asbestos, Vermont, f.o.b. Hyde Park:			
Spinning fibers	$353	@	$383
Shingle stock	$172	@	$190
Paper stock	$114	@	$145
Waste, stucco or plaster			$82
Refuse or Shorts	$39	@	$72
Barytes f.o.b. cars:			
Georgia, crude, per ton			$18
Missouri, 94% $BaSO_4$, per short ton			$16
Crude oil well grade, min. 4.3% sp gravity, st			$11.50
Bauxite, long ton, f.o.b. point of shipment:			
Domestic crude, 50 to 52% (not dried)	(a)$5.00	@	$5.50
Domestic, chemical, 55 to 58%	(a)$8.50	@	$9.05
Domestic, abrasive, 80 to 84%	(a)$18.00	@	$18.50
Imported metallurgical, per lt, job Br. Guiana, dep. on grade	$6.00	@	$7.00
Feldspar, bulk ton:			
Potash or soda feldspar, 200 mesh, ceramic grade	$18.50	@	$22.25
Glass feldspar, white, 20 mesh	$11.75	@	$12.50
Fluorspar, f.o.b. mines, bulk, 72½% effective, ton	$37	@	$41
60% effective CaF_2	$33	@	$36.50
Acid 97% concentrate, bulk, ton	$52.50	@	$55
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00	@	$14.00
Magnesite, per ton dead-burned, bulk, f.o.b. Washington			$40.00

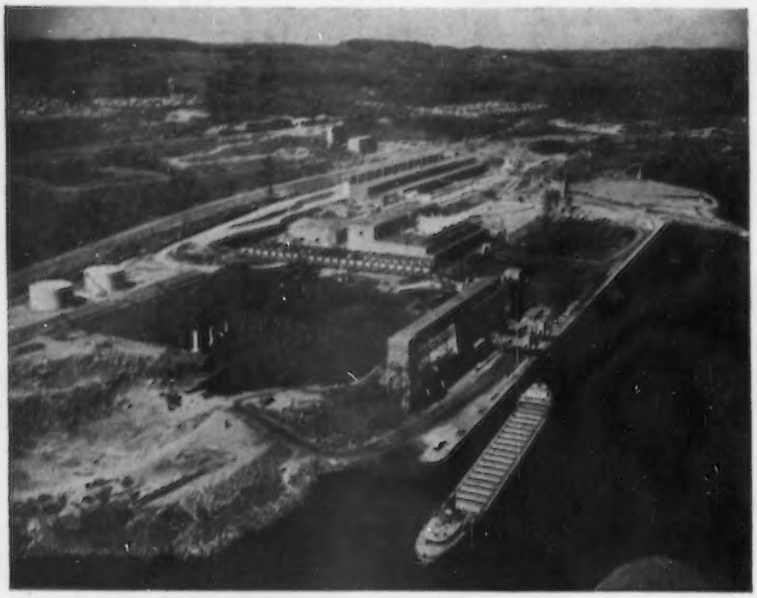
Mica—Domestic, f.o.b. mines. Punch 7¢ to 12¢ per lb according to size and quality. Sheet clear, 1½ x 2-inch, 70¢ to $1.10; 2 x 2-inch, $1.10 to $1.60; 2 x 3-inch, $1.60 @ $2.10; 3 x 3-inch, $1.80 @ $2.30; 3 x 4-inch, $2.00 @ $2.60; 3 x 5-inch, $2.60 @ $3.00; 4 x 6-inch, $2.75 @ $4.00; 6 x 8-inch, $4.00 @ $8.00. Wet ground, very fine, $140 @ $155 per ton. Bulk sales, dry ground: $32.50 @ $70.00 per ton. Scrap $25 and up.

Ocher, Georgia, ton, in sacks	$26.50	@	$30.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports			Not quoted
Sulphur, per lt f.o.b. U. S. mines: bright			$26.50
dark			$25.50
Talc, f.o.b. works, ton:			
New York, purified	$18.50	@	$20.00
Vermont, extra white			$12.50
Tripoli, Missouri, ton:			
40-mesh, cream colored			$50.00

(a) Nominal.

IRON AND STEEL

Pig Iron, gross ton, basic, Valley Furnaces			$62.50
Steel f.o.b. Pittsburgh, billets, net ton			$74.00
Structural shapes, Pa., Ala. etc., 100 lb	$4.85	@	$5.00



SILVER BAY, where Reserve will produce 3.75-million tons a year of 62.5% Fe, sintered pellets, has plenty of storage space and an excellent, fast-turnaround dock.

Reserve Taconite Onstream

UNDERWAY SINCE 1951, Reserve Mining Co. formally opened the Babbitt and Silver Bay processing centers with dedication ceremonies Sept. 12 and 13. This $190-million project includes the E. W. Davis Works at Silver Bay, the mine and pilot plant at Babbitt. How this program came into being, its operations and how the people of Minnesota stand to benefit from a wise taxation policy will be the subject of a forthcoming issue of *Engineering & Mining Journal.*

Of real significance in Reserve's history and in the development of taconite is the 1941 act of the Minnesota Legislature—the Taconite Law. This limits amount of ad valorem tax that can be assessed on taconite land, its mining and processing. Instead of the usual ore-in-the-ground tax, only production taxes are levied on the high-grade pellets that will roll out of Reserve's sintering furnaces at the rate of 3.75-million tons a year.

Even so, Minnesota stands to develop tremendous tax revenues from taconite projects that are sure to follow Reserve, since more than 95% of the Mesabi Range is taconite. And without this tax policy, none of these projects would be possible, since the method itself is costly.

Reserve Mining Co. is owned by Republic Steel Corp. and Armco Steel Corp. This project covers a vast orebody of magnetic taconite on eastern tip of the Mesabi, St. Louis County. It is about 9 miles long, 2,800 ft wide and as much as 175 ft thick in an orebed that dips 5 deg. Reserves in this orebody exceed 1.5-billion, 25% recoverable iron, with additional deposits nearby.

Basically the process is as follows: Reserve will mine and crush to two stages at Babbitt, using the world's largest primary crusher (3500 tph) and a 30-in. gyratory to break to 3-in. rock. Then the ore will be sent to Silver Bay over Reserve's own railroad for rod milling and rougher magnetic concentration with 30% of the gangue being discarded at the roughers.

This will be followed by ball milling and several stages of cleaner concentration on magnets to yield a final concentrate for drum filtering. After filtering, concentrate will be balled in balling drums and hardened in sintering furnaces to yield pellets, 62.5% Fe. The process turns out one ton of pellets for every three of taconite fed in.

Not only will this process make use of low-grade ore, but the pellets are said to increase blast furnace capacity by about 10%, through their size, shape and partial reduction to iron.

E. W. Davis works will produce 3.75-million tons a year, treating some 10-million tons ore—a feat that introduces problems in itself. Taconite rock is harder than quartzite and at these tremendous feed rates, the wear problems are almost fantastic. In the first unit, built at Babbitt and still used as a pilot plant, almost 1-million tons of ore was handled a year. This was Reserve's pilot plant, turning out 300,000 tons of finished pellets annually. This pilot plant has been duplicated 12 times at Silver Bay.

In taconite, the wear problems have been licked, jet-piercing has been developed to its present art, and Professor Davis's method has been proven economic. How all this was accomplished will be the subject of *E&MJ*'s upcoming report: the mine; the railroad; the mill; the modern, pleasant mining community; the loading dock with its large winter-pellet storage space and modern, fast-turnaround docking facilities.

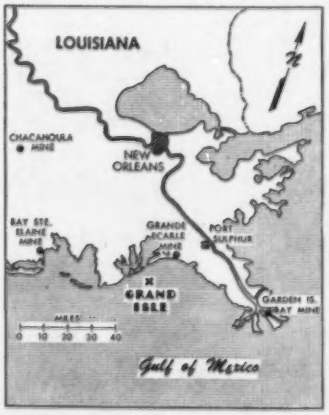
Freeport Will Mine Offshore Sulphur Dome

FIRST COMPLETELY OFFSHORE sulphur mining project in history will be undertaken by Freeport Sulphur Co. at deposit discovered in Gulf of Mexico by Humble Oil & Refining Co. Deposit, known as Grand Island—Block 18, is located in 45 ft water, six miles from nearest land, off coast of Louisiana.

Under contract signed by the two companies, Freeport will design, install and operate the Frasch plant. Construction will start in 1958 and will take about two years.

"The find ranks among the most important sulphur discoveries in recent years. Sulphur was struck approximately 1700 ft below the Gulf floor in salt dome cap-rock," announcement stated.

Contract also involves sulphur rights to two other offshore domes: Block 16, 6 miles east of 18; and Block 30, 12 miles to the east. Under this contract, Freeport will pay royalties to Federal Government and split net profit with Humble Oil. When in operation, the sulphur will be pumped into insulated barges and then moved to Port Sulphur in molten form.



Daniel P. Eigo

Atlas-URC Deal Ends Lisbon Valley Mixup

HIDDEN SPLENDOR MINING Co. has acquired a 30% equity interest in Uranium Reduction Co. in a multi-million dollar transaction. (*E&MJ*, Sept. 1956 p 73.)

As a consequence, the subsidiary of Atlas Corp. has dropped plans to build a 2,000-tpd ion-exchange process uranium mill at La Sal, San Juan County, Utah.

Uranium Reduction Co., controlled by Charles A. Steen and associates, is completing construction of an $8.5-million concentrator on banks of Colorado River at Moab, Utah.

Amount Hidden Splendor will pay for the URC stock was not disclosed. Reports of a $5-million figure were denied by Mitchell Melich, Moab, URC president.

However, Hidden Splendor and Atlas agree to:

1. Arrange financing of up to $2.5-million for URC covering installation of a carbonate leach circuit at the Moab mill, made necessary by elimination of lime penalties on ores in the area by AEC.

2. Commit all wholly-owned ore supplies, ore supplies of associated firms and ore contracts which Ute Milling Co. (the proposed vehicle for the mill) held with independent producers.

These include: Almar orebody, Cal-Uranium (San Juan orebody) Radon orebody operated for Rado-Rock-Resources by Hecla Mining Co.; Lisbon Uranium Co. orebodies; ore contracts with Homestake Mining Co. covering production from La Sal and Little Beaver mines.

These properties, with Steen's Utex Exploration Co.'s Mi Vida mine and Standard Uranium Corp.'s mine, would then flow ore into the URC concentrator.

Only major orebody in the Big Indian District, one of the nation's largest deposits, that is not committed in one form or another to the URC mill is the Cord orebody.

Commitment of the Homestake ore contracts is placed on a "best efforts basis." Under the original proposal for a mill made to AEC by Ute Milling, Homestake had option to acquire an interest in that mill.

3. Atlas and/or Hidden Splendor would name three directors to URC board in expansion of that board from 7 to 10 members. It is reported, but not confirmed, that D. H. McLaughlin, San Francisco, Homestake president, had been offered one of these directorships.

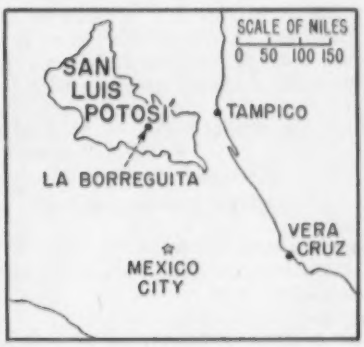
4. Charles A. Steen et al remain the largest equity holders in URC.

Steen retains the original right under trusteeship agreement to name members of the board of directors of URC. (This will be amended of course, to permit Atlas-Hidden Splendor to name three.)

(*Continued on p 128*)

As we go to press . . . . . .

A huge new gypsum find is reported in the state of San Luis Potosí, Mexico. The entire deposit isn't yet explored, but 300-million tons of commercial grade gypsum are already blocked out. U. S. Gypsum is said to have plans in the offing for project development—both at the desert site and at the Tampico docks—running into millions of dollars. Initial production will be geared to a rate of about 30,000 tpm and should begin late next year through the U. S. G. Mexican associate, Yeso Mexicana. Smaller leases in the states of Puebla and Colima have been signed.



New Park Mining Co. has reopened its Park City District mine with 175 men on the work force, 115 fewer than when the operation shut down early last month (see p 130). Intention is to concentrate on development and production of the copper ores occurring in the western sector of the Utah mine. And fingers are still crossed on the $250,000 DEMA grant.

Three new central African companies, all subsidiaries of London's Rio Tinto Co., have been formed, with a total authorized capital of nearly $3.8-million. Among the claims optioned are those of the British South Africa Co. in Northern Rhodesia, and the Empress nickel claims near Gatooma, Southern Rhodesia.

Bolivian gold fields will be developed by an American firm, South American Gold & Platinum, according to a 25-year contract just signed covering 37,000 acres in the river area of the Alto Beni. Royalties are on a sliding scale, reaching to 30% for ore mined during the last 15 years containing better than 1,000 milligrams gold per cubic yard.

Titanium produced by the sodium reduction process will be a commercial reality in the Ashtabula, Ohio, plant United States Industrial Chemicals Co., recently acquired from Lake City Malleable Co. USI hopes to be in production by late 1957. Stauffer Chemical Co. is building a new titanium tetrachloride installation in Ashtabula to supply the USI works.

Defense Minerals Exploration Assistance drilling contract, just completed by American Zinc, Lead & Smelting Co., shows that American Zinc has approximately 35-million tons in the southwest New Market area, Tenn. This, according to Howard I. Young, president, is equal to the known reserves in company's active Tennessee properties.

American Zinc has signed another DMEA contract to explore in Strawberry Plains area to the east of Mascot. In addition, exploration drilling at Piquette, Wis., has raised ore reserves there by 20%.

Behind the By-Lines...

G. P. Lutjen

With all hands just back from the big AMC meeting in LA we thought that the following might strike a responsive chord. It happens to be the second time in the last 12 months that we've run (or should have run) apologies to Frank Sullivan, but there's just so much talent around and he's got a lot of it.

The Cliche Expert on National Conventions
By Owen E. Lyons
Advertising Manager, Marathon Corp.
(With apologies to Frank Sullivan)

Q. As association secretary, you plan the national conventions for your association, Mr. Arbuthnot?
A. I do

Q. Where do you hold your conventions?
A. In romantic New Orleans, dynamic Dallas, cosmopolitan San Francisco, interesting Chicago, miraculous Miami, mighty New York. We hold them in cities that all roads lead to.

Q. You plan the convention program also?
A. Yes, indeed.

Q. What kind of a program do you plan?
A. A potent program. Practical. Full of down-to-earth, usable help.

Q. Packed with ideas?
A. No. Jam-packed with ideas. A program that's made-to-order to meet today's tough competitive battle. A program you and other top executives of your company will certainly want to participate in.

Q. What kind of speakers appear on your programs?
A. Inspiring speakers. Distinguished speakers. Well-equipped-by-experience speakers. Speakers no one can can afford to miss, except that quite a few do miss hearing them.

Q. Why do they miss, Mr. Arbuthnot?
A. They are tired after the Past Presidents' Twilight Reception, the Moonlight Excursion on the old side-wheeler Natachez and getting up at six o'clock for the daily Sleepy Head Breakfast Meeting.

Q. Your convention program consists principally of speeches and reports?
A. No, indeed. We have shirt sleeve sessions. We get down to brass tacks. We trade know-how. See my jacket sleeves?

Q. What caused those holes, Mr. Arbuthnot?
A. Rubbing elbows caused it. Rubbing elbows with others in my business at our convention sessions. We have open and free discussions. We smoke things out. We pull no punches. We get the benefit.

Q. The benefit?
A. Yes. The benefit of the thinking of the other fellow which helps us meet changing business conditions.

Q. You also arrange hotel reservations?
A. Yes. Make them now if you haven't already done so. See the card attached. Rooms will be at a premium. Cabana twenty dollars extra . . . What rhymes with "eight"?

Q. Eight?
A. Yes. How do you like: "The Plans are Great for '58?" Our slogan man works two years ahead.

Q. You are planning your 1958 Convention now?
A. We are planning a potent program. Practical. Full of down-to-earth usable help. Jam-packed with ideas. A program that's made-to-order for 1958's tough competitive battle. A program you and other top executives of your company. . . .

Q. Thank you, Mr. Arbuthnot.
A. *Thank you.*

Our Sign-of-the-Month Department is about ready for an Amended Signs Division. We just heard about a safety sign which read "School—Drive Carefully—Don't Kill a Child." Beneath was a 4th grade scrawl—"Wait for a Teacher."

Return engagements are being played by a number of this month's authors and we're awfully pleased to have them back.

Langbourne M. Williams, president of Freeport Sulphur Co., and author of our annual sulphur review these past 5 years, digs into nickel this time. The nickel situation may be unrecognizable in another few years and on p 75 Mr. Williams tells why. He ought to know because he has a hand in shaping the changes. Incidentally this article is in the issue as a result of some astute eavesdropping at a recent meeting of the Mining & Metallurgical Society of America.

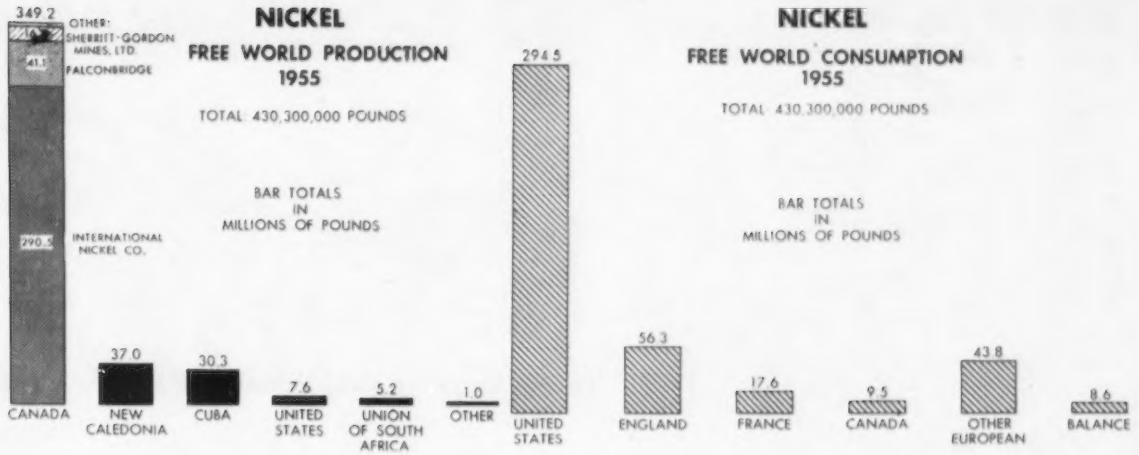
Dr. E. W. Inett follows up August's Rotary Percussive Drill study with a pro and con piece on cross bits vs chisel bits on p 76. Readers with sporting blood will kindly place their bets before turning thereto.

Prof. T. M. Morris of Rolla had his last by-line in *E&MJ* in June 1952 underneath "Measurement of Retention Time in Flotation Machines." This trip he and Mr. W. R. Horst tell us about some experiments at Rolla which could benefit the mill man. See p 81.

Dr. Raymond E. Vener of Catalytic Construction Corp., who has the knowledge, experience and energy to fill a whole issue several months hand running, weighs in this month with a definitive piece on moving-bed processes. In July he tackled metallurgical classification and solids-gas contacting, a prodigious output for an engineer holding down a full time job of work.

We are often astounded by the thoroughness with which our Books editor goes through the dozens of tomes that pile up on his desk each month. How else would he dredge up the fact that on p 252 of V. S. Dillon's 603-page volume, "Assay Practice on the Witwatersrand" are found complete details for assaying Kaffir beer?

Come to think of it, those Rand assayers are pretty thorough themselves.



New Era in Nickel

LANGBOURNE M. WILLIAMS

WHAT MAKES NICKEL of such special importance at this stage in world history is that it is absolutely indispensable for all the most important activities having to do with our defense effort—in atomic energy, in electronics, in jet engines, in guided missiles. The budget for the Air Forces today is about $16-billion. This compares with $1.5-billion in 1948 and with the figure of $11.8-billion as the total expenditure for national security in fiscal 1948. The Defense Department is spending about $3-billion a year on electronics, and atomic energy expenditures in 1957 will be nearly $2-billion.

Jet planes, guided missiles, electronics, atomic engery activities all have at least one major thing in common—they are completely dependent on nickel. What the real demand in years ahead will be no one can say. We do, however, have a few clues.

A recent report by the Department of Commerce includes the following statements: "The most significant factor in the increase in defense consumption of nickel lies in the technological changes in the aircraft program. . . . There seems to be a number of reasons for the increase in nickel consumption for jet engine production. . . . With the increase in thrust requirements and consequently higher engine operating temperatures, new and better alloys are constantly required.

"Probably the most significant of these potential changes," the statement continues, "has to do with increase in speeds of aircraft to such an extent that aluminum or even titanium will not stand the heat generated in high speed flight. There have been various indications from the military and a number of reports from the aircraft industry itself indicating that nickel-bearing stainless steel will be required in the not too distant future for the skins and structurals of aircraft where aluminum is now being used. The public press of Friday, Aug. 3, carried a news story on this subject which is highly significant. The Bell Aircraft X-2 rocket plane reached a new high speed of 1900 mph. This craft is constructed practically entirely from nickel-bearing stainless steel and K-monel, an alloy which contains 65% nickel."

Continuing to quote from this report from the Department of Commerce: "Requirements for nickel in new construction and maintenance for the Atomic Energy program have been and will continue to be quite substantial. . . . Other potential uses of nickel in the defense program are those concerned particularly with guided missiles and electronics. . . . It is difficult to estimate the possible future effect on nickel requirements of these two programs, except that they will be substantially increased."

Demand on Increase

What we can say about demand for nickel, therefore, is that it has been increasing rapidly; that it is expected to increase further; and that it is expected to increase in the areas of most critical concern for the safety of the world.

What we can say about supply is that there is an acute shortage. If there is an Achilles heel in the armor of the United States that Achilles heel is nickel.

Let me draw you a picture of supply and demand—the production and consumption of nickel in the Free World.

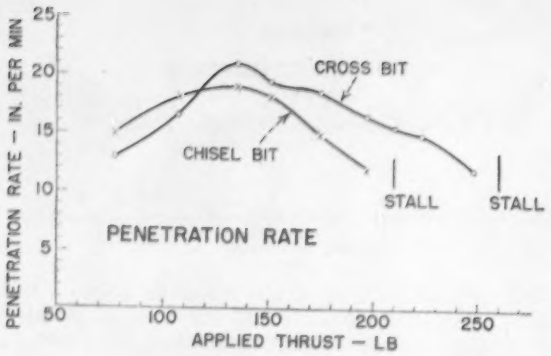
The chart above shows production in 1955. It shows that 80% came from Canada. In fact, more than 65% of the production of the free world in 1955 came from one company, the International Nickel Co., which in one of the truly great performances of industrial history has literally created the present day nickel industry. While the contributions to our present strength made by this company have been outstanding, we have come to lean so much on this one source that this dependence in the present state of world affairs constitutes an actual weakness. One bomb placed by sabotage or dropped from the air on the smelter at Copper Cliff could most damagingly cripple our defense effort in all its vital segments.

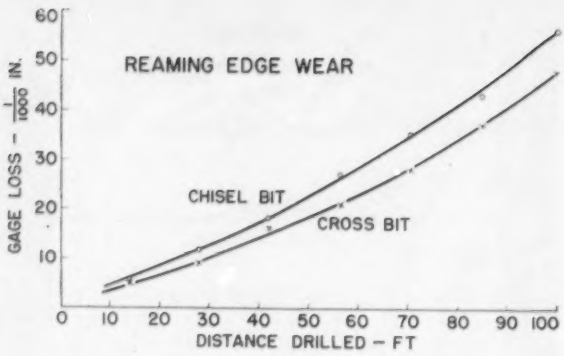
Where did this production of 430-million lb go? The chart above shows the distribution.

With defense taking so much, supplies to industry have been, of course, curtailed, and in recent times the shortage has been extremely severe. In 1953 nickel was relieved from the Government allocation controls which had been initiated when the Korean War started, and since then Inco has been primarily responsible for the system of voluntary allocation that has been in effect. That the shortage has been acutely felt has of course been emphasized by the price at which nickel has been selling. While

(*Continued on p 124*)

Mr. Williams is president of Freeport Sulphur Co. This article has been excepted from a talk given before the Mining and Metallurgical Society of America Sept. 13, 1956 in New York.





These Areas of Performance Were Checked

FIG. 1. Drilling speed hits peak with cross bit. Chisel, faster at low thrust, falls behind cross at high thrust.

FIG. 2. Loss in gage is likewise less on cross bit because of greater surface exposed by four wings than by two.

How Cross and Chisel Bits Compare

E. W. INETT, Ph.D.

DRILLING TESTS with chisel and cross bits have produced conflicting results over the last 20 years or so. In certain rock types some investigators found cross bits to drill faster than straight chisel bits of same diameter; other found reverse to be true in comparable rock types.

Dr. Inett has made a number of reports on investigations into penetrating rock. His work is being done in the Mining Department, University of Birmingham, England.

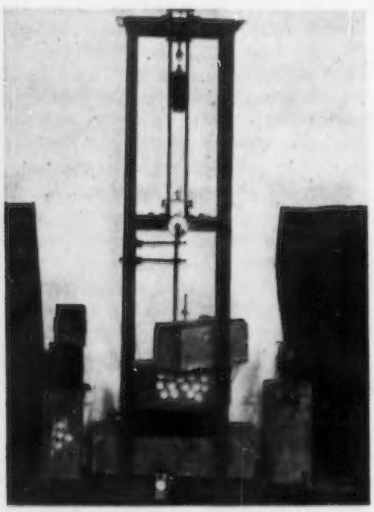
Results reported by workers often have failed to be widely applicable, or have not been always fully acceptable. In main, this is because they are obtained either underground on full-scale operating rigs where precise control of contributory factors is generally impracticable and so do not satisfy those primarily concerned with fundamentals of the problem; or because laboratory techniques have been employed which frequently do not appeal to the essentially practical operator since they may appear to bear little relation to any drilling process proper.

For these reasons, in tests reported here, an attempt has been made to marry the two approaches in an experimental apparatus capable of adequate control, yet employing conventional full-sized drilling equipment, with some unavoidable concession to expediency in both respects.

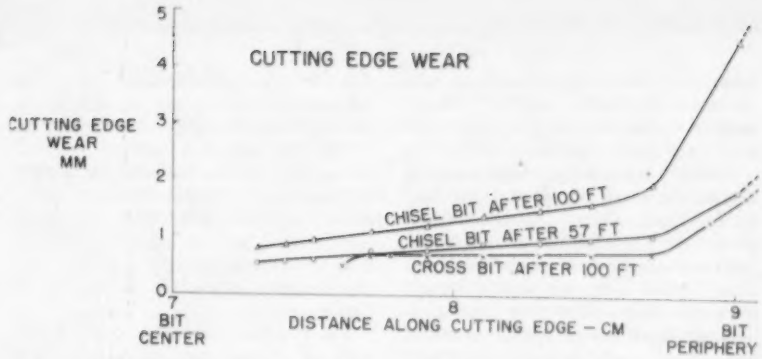
Previously described in some detail by Cheetham and Inett, 1953,[1] the rig is shown in illustration. Provision is made for controlling drill equipment, operating air pressure, water or air

This Equipment Was Used By Researchers to

SPECIAL DRILL RIG used for full scale testing of cross versus chisel bit.



JUMPER tests one-blow penetration.



For Two Different Bit Types

FIG. 3. Cutting edge wears less on cross bit, partially explained by greater wearing surface presented by the cross bit.

I—The Basic Data on Performance

Applied thrust lb	Chisel bit Rotation rate rpm	Chisel bit Penetration rate in. per min.	Cruciform bit Rotation rate rpm	Cruciform bit Penetration rate in. per min
78	244	15.0	255	13.5
108	204	18.0	210	16.5
135	140	19.0	180	21.0
151	100	18.0	111	19.5
151	99	18.0		
175	72	15.0	99	18.5
197	56	12.0	84	16.5
210	—	stall	80	15.5
223			75	15.0
248			51	12.0
260			—	stall

Used 1½-in. tungsten-carbide bits. Air—80 psi, water—70 psi.

II—How Speed Drops

(Penetration rate—in. per min.)

	At start	After 28 ft	After 57 ft	After 85 ft
Chisel bit	17.0	12.5	10.0	8.5
(Per cent reduction		26	41	50)
Cross bit	19.0	16.5	15.0	14.0
(Per cent reduction		13	21	26)

Used 1⅝-in. tungsten Carbide bits.

in Performance

flush and oil feed; for measuring piston blow rate, drill steel rotation rate, length of piston stroke and penetration speed; and for collecting cuttings produced during drilling.

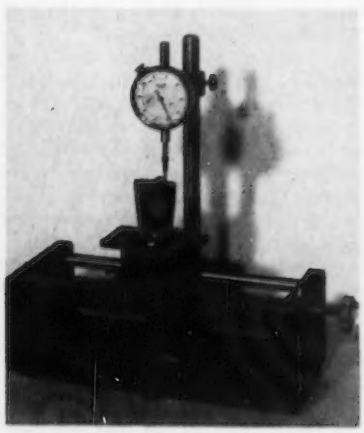
In majority of tests, a drill of following specification was used: Bore, 2⅝ in.; Nominal stroke, 2 in.; Length, 20 in.; Weight, 48 lb; Rifle bar pitch—1 revolution per 30 in. of piston travel.

Valve was of thin plate type without kicker ports and water feed was of conventional water tube type. Since experiments were carried out in a horizontal plane, weight of drill was important only with respect to its inertia. Piston diameter, stroke and weight were contributory factors to energy of each blow—a factor not specifically dealt with in this paper.

Drill rods were of high carbon steels, ⅞ in. hexagon section, 4 ft long and having shank lengths ½-in. greater than chuck length. Bits used throughout were either 1½- or 1⅝-in. diameter—tungsten carbide tipped, cross or single chisel bits, or steel cross bits containing 0.7% carbon and 0.3% magnesium.

One rock type was used. Darley Dale Sandstone—a New Red Sandstone series rock, moderately coarse sandstone consisting of angular quartz, feldspar and traces of white mica cemented by silica.

Make the Comparison



PROFILE OF BIT produced by wear during tests was measured with this instrument. Micrometer checked gage loss on steel tested.

Fundamental Considerations

An attempt was made to approach problem from first principles starting with standard cutting edges and applying controlled blow intensities. A homogeneous medium in which to carry out the tests was of prime importance. No type of rock was suitable, not only because of its heterogeneity but also because of difficulty of measuring penetration depths after impact. Variety of media was tried, including plastics and granular artifacts. A block of lead gave most consistent results.

"Standard Jumper," shown in photo, was developed to show effect of a single blow on rock or composite surfaces and to study mechanism of rock breakdown. It consisted of an angle-iron framework, 10 ft high and 2 ft square, firmly bedded on ground. Two guides located in top portion permitted dropping 30-lb cylindrical weight from known height onto shank end of a drill steel located in lower portion of framework. Weight was raised by manually operated winch and released by quick-release mechanism when at required height. Drill steel was freely held by retainers which permitted imparting incremental manual rotation to steels. Range of bit sizes and designs could be attached to lower end of drill steel. Rebound of dead-weight was eliminated by use of arrestors thus enabling a clean blow to be given to specimen under test.

Measurements of depth of penetration per blow for a range of cutting edge lengths and impact forces were made. As might be expected, for a given cutting edge angle, depth of penetration varied inversely as a function of length of cutting edge. Figure 4 gives results. They show chisel bit with a cutting length half that of cross bit will penetrate less than twice the depth of cruciform bit, all other factors remaining constant, at least during plastic stage of deformation.

However, in removing one complete slice of rock from face of hole, chisel bit rotates through 180 deg while the cross bit rotates through 90 deg only. Thus in one complete revolution chisel bit will remove two complete slices of rock against four complete slices removed by cross bit. But since chisel bit does not penetrate twice as far as cross bit (with twice the length of

New Bit Design Improves Performance

It is my opinion that nearly all present day percussive drill bits suffer from the disadvantage of inadequate chipway space.

One of main conclusions reached by rotary drilling research workers was that, with present day equipment, clogging and the associated problem of clearing debris from cutting edges of bit were the overriding factors which ultimately determined maximum penetration rates. The stage at which stalling commenced depended upon passage available for cuttings to escape past body of bit into scroll of rod in the case of rotary drilling. These workers conclusively showed that high penetration rates were achieved when cuttings suffered little additional comminution after their initial production. These findings now appear as applicable to percussive drilling as to rotary drilling.

When cuttings are not rapidly removed from bit edges, they reduce speed by absorbing much of the energy of successive blows. This causes a reduced penetration per blow and consequently a reduced penetration rate. Such debris accumulations also increase resistance to rotation and tend to cause earlier stalling of the drill by piston/rifle bar interference.

Relative ease with which cuttings can escape from the edges of a rotary bit is clearly shown by visual examination. Rotary drilling debris generally has ample exit space available under actual operating conditions but it would seem that this aspect of percussive bit design has not received the attention which it merits. There are some percussive bits available that have only 4% chipway space!

Various modifications were made to basic designs of existing bit types in an attempt to facilitate production of coarser cuttings and provide adequate space to enable this debris to be swept away in a relatively unbroken state.

High-speed photographic records of the drilling process showed that, provided rotation is suitable, larger cuttings are formed towards periphery of bit. Rock at and near the center of the bit suffers greatest comminution under any degree of rotation. Some bit types, both chisel and cross, do have a small center portion which is free from tungsten carbide. Sometimes it is used for locating flushing hole; more often than not it is part of body steel. Profile tests on apparatus used to determine bit wear (See photo) have shown that this portion is subjected to very little wear and suggest that its usefulness is limited.

Tests were conducted to show effect of center core on penetration rate. Series started with a 1¼-in. diameter single chisel bit and operating conditions were maintained constant at 80 psi and 150 lb applied thrust. Diameter of the center core was progressively increased and resultant penetration and rotation rates measured for each test condition. Experimental bit type is shown in photo.

Penetration rates increased up to maximum by allowing small rock core to form in the center of bit. Further increase in core diameter reduced the penetration rate. Formation of core, although it never exceeded more than

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cutting edge) at each blow, the cross bit advances a greater linear distance than chisel bit for each completed revolution—theoretically.

Penetration Rate

Practical comparison of the bit types was made on the full-scale test rig. Table 1 and Figure 1 show results. At low thrusts chisel bits drill at a faster rate than cross bits of same diameter, but as thrust increases the cross tends to drill faster than the chisel. Reason for this is related to rotation during tests.

At lower thrusts (most inefficient stage of drilling with respect to energy utilization), high rotational speeds give greater angular distance between successive blows and enable full effect of chisel bit's deep penetration to show up to advantage—Figure 5 (a). Angular distance between successive blows is too great for shallow penetration of cross bit to remove all intermediate rock and ridging occurs—Figure 5 (b). Thus whole of rock base is not removed during 90-deg revolution of cross bit and penetration speeds are considerably reduced.

As thrusts increase and rotation rates tend to decrease, full effect of shallow penetration of cross bit becomes apparent. Angular distance between successive blows is naturally less with slower rotation and ridging between blows experienced with cross bits at higher rotation rates is eliminated. Some overlapping of effect of successive blows is experienced with chisel bits at slower rotation rates and hence some potential drilling speed is wasted.

These conditions lead to cross bits drilling faster than chisel bits above a certain thrust.

Figure 1 also illustrates that chisel bits will stall before cross bits. Reason for this is that higher thrusts tend to keep cutting edges well up to rock face and eliminate rebound—but there must be some rebound or resilience in system to enable tips to disengage from rock and steel to rotate. With deeper penetration per blow of chisel bit, rebound is not sufficient to permit steady rotation and rotational resistance is so increased that drill rapidly stalls. At comparable thrusts, shallower penetration of the cross bit permits easier rotation. Thus rotational effects also have some influence in maintaining higher penetration rates of cross bits.

It would appear, therefore, that rotation is a dominating factor in comparing speeds of chisel and cross bits. To obtain maximum benefits from cross bits, rotation rates should be lower than those of chisel bits since shear forces induced will be less.

Mode of Bit Wear

Since general mode of bit wear has recently been reported by Inett, 1956,[2] only conclusions are summarized here. Apparatus used for measuring cutting edge wear is shown in photo. Gage wear was measured with micrometer.

Wear at outside corner is most severe and is shown to occur in two ways. Firstly, a very rapid removal of actual cutting edges followed by a tendency to flatten edges. Secondly, a gage loss tending to reduce effective diameter of bit.

Bit design ensures that the initial diameter across cutting edges is maximum bit diameter. As gage end of cutting edge is worn away and begins to assume a curved profile, effective diameter across cutting edges is reduced. Thus portions of tapered reaming surface are of equal diameter to cutting edges themselves. At this stage gage wear will inevitably take place in an attempt to keep the maximum diameter across reaming surface less than that across effective cutting edges. Thus it can be said that gauge loss is an enforced method of restoring cutting corner of bit.

Middle portion of cutting edge wears comparatively uniformly, while innermost (center hole) portion tends to flatten out and lose inner facet on cutting edge. This facet is progressive-

about 5/16 in. in depth, increased the resistance to rotation and, in consequence, reduced overall rotation rate.

With 1½ in. diameter bit, up to 35% speed increase was possible with core diameter of ⅜ in. Bits of smaller diameter required smaller cores and of larger diameter, larger cores to maintain such speed inceases. In general, however, core diameter of 25% of length of cutting edge gave comparable results.

Of course maximum size of core depends upon physical properties of rock type being worked. Core diameter should be such that rock core is frequently broken off at base. Cores of excessively large diameter would wear down only by "sitting" on bit body, but even under these conditions, i.e. with ⅞ in. diameter core in 1½ in. diameter bit, penetration rates obtained were still slightly higher than those obtained with standard bits.

Observation showed that an increased overall size of debris was obtained with core bit. With ideal core size (when cores broke off at base) fairly larger-sized cuttings were produced. Over-all size diminished as bit penetrated further into rock, thus illustrating the effect of secondary comminution, that is, frictional effects within drilled length. Debris size was largest at maximum penetration rate and, overall, there was a lower percentage of fine dust produced.

By such bit modification a considerable saving in tungsten carbide may be achieved, i.e. ¼-in. savings in total carbide length of 1⅜ in., or 18% of total. By such treatment, bit life does not appear to suffer to commensurate extent in softer rocks and even in rocks of 70 to 75 Shore Hardness the life diminishes by only about 6%.

Removal of a central slot does not appear to cause any tendency to flake at corners or to cause insert fracture until width of slot exceeds that at which maximum drilling speed is achieved.

Further modification of bit to produce an increased sludging efficiency may be carried out by partial removal of dummy wings of bit and of shoulders of insert wings. The slot may then be extended down the sides of the bit between those wings which lie on leading (forward in relation to rotation) side of carbide insert. If channel is cut on rear side of insert wing, then insert failure in hard rock becomes frequent. However, in both hard and soft rocks insert failure is rare when channel is located in advance of the cutting edge.

PROPOSED CHISEL BIT has large center slot and increased chipway space.

ly eliminated until middle and innermost sections of cutting edge are, more or less, as one.

This general mode is same for both cross and chisel bits, as illustrated by Figure 6.

Chisel and cross bits can be expected to differ in their rates of wear. Since the cross bit possesses twice effective cutting edge of chisel bit it should possess longer drilling potential. This in some way helps to compensate for higher initial cost of the cross bit —more particularly when it is tungsten carbide tipped.

Comparison of profiles in Figure 6 show that all parts of cutting edges of chisel bits wear more rapidly than those of cross bits operating under otherwise identical conditions. Across innermost portions of the individual limbs, the wear of chisel bit exceeds that of cross bits in ratio of 3:2. This ratio increases with increasing diameter until at periphery, ratio is 3:1. Figure 2 also shows a comparison between wear after 100 ft of drilling with cross bit and after only 57 ft with a chisel bit. Wear of latter exceeds that of the cross at all parts along its cutting edges. It illustrates that prolonged drilling with chisel bit causes a rapid deterioration in potential drilling life.

Gage loss is also shown to be more severe for chisel bit, but not to the extent of the 3:1 ratio for cutting edge wear. Figure 3 shows varying rate of gage wear and that gage loss is in-

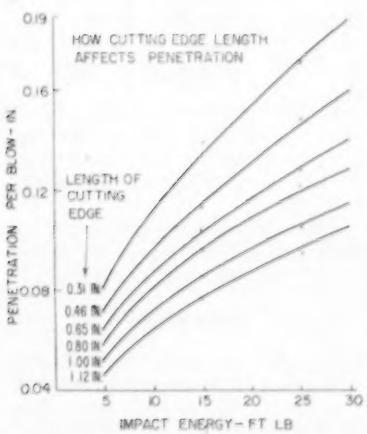


FIG. 4. Penetration is non-linear.

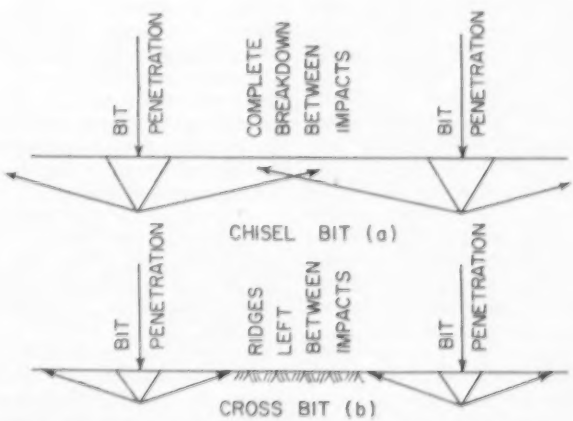
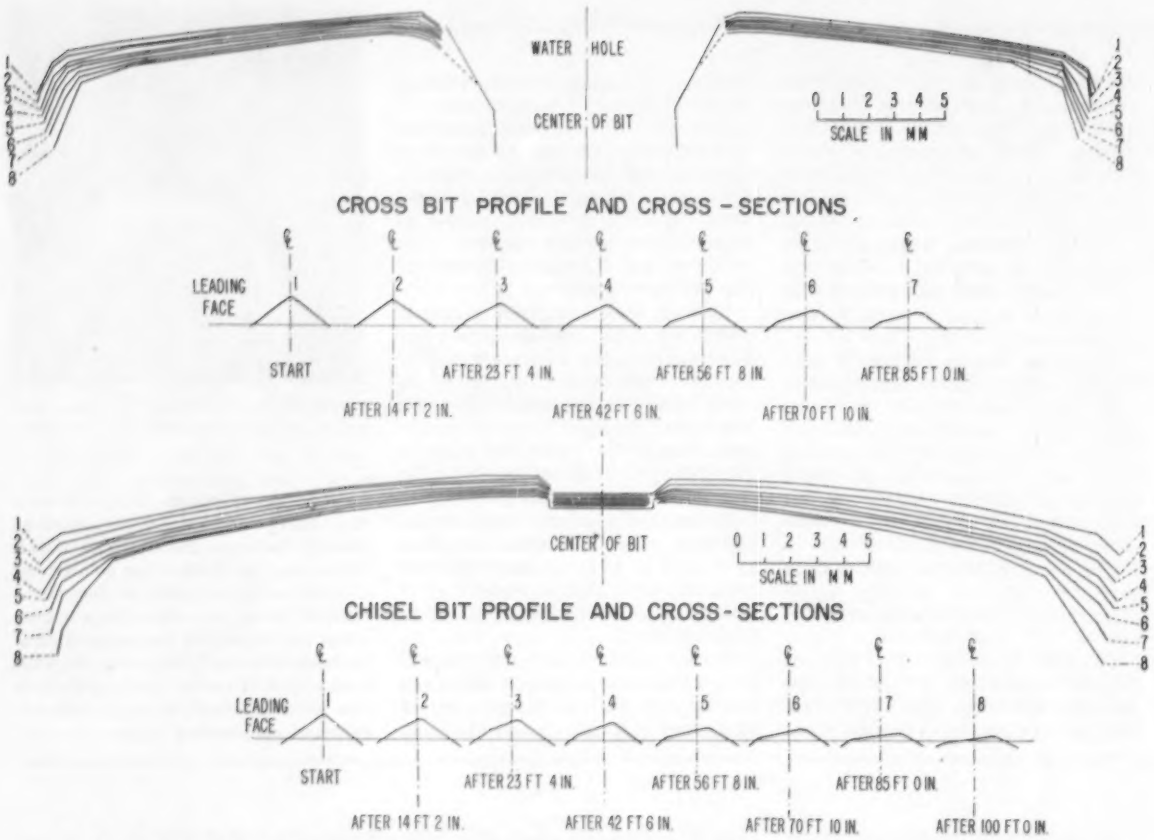


FIG. 5. Chip pattern shows why chisel bit's deep cut at low thrust is best.


WATER HOLE
CENTER OF BIT
0 1 2 3 4 5
SCALE IN MM
CROSS BIT PROFILE AND CROSS - SECTIONS
LEADING FACE
START
AFTER 14 FT 2 IN.
AFTER 23 FT 4 IN.
AFTER 42 FT 6 IN.
AFTER 56 FT 8 IN.
AFTER 70 FT 10 IN.
AFTER 85 FT 0 IN.
CENTER OF BIT
0 1 2 3 4 5
SCALE IN MM
CHISEL BIT PROFILE AND CROSS-SECTIONS
LEADING FACE
START
AFTER 14 FT 2 IN.
AFTER 23 FT 4 IN.
AFTER 42 FT 6 IN.
AFTER 56 FT 8 IN.
AFTER 70 FT 10 IN.
AFTER 85 FT 0 IN.
AFTER 100 FT 0 IN.

PATTERN OF CUTTING EDGE WEAR is similar for both bit types, although chisel's is greater in magnitude.

creasing at an increasing rate as over-all drilling depth increases.

It might be expected that the bit subjected to highest rotation rate would suffer greatest wear. However, reference to "Rotation" in Table I shows this is not so. It is combination of high intensity of cutting edge loading and increased resistance to rotation in the case of the chisel bit which has led to increased wear in spite of the fact that the cross bit may have covered a much greater angular distance when penetrating a given linear distance. Of course, if in addition to working under these impositions, the chisel bit had been rotated at same rate as the cross bit, difference in wear rates would have been even more pronounced.

A most important aspect of bit wear is its influence on penetration rate. Table II, obtained during wear comparison tests, illustrated by profiles in Fig. 6, shows that comparative reduction in penetration rate is maintained at a fairly constant ratio of approximately 2:1 in favour of cross bit. Very rapid speed loss of chisel bit is probably due to rapid wear of cutting corners (see Figure 6) after which rotation becomes more difficult due to friction between reaming surface and hole. This in turn influences piston stroke and strength of blow. (This effect is fully discussed in the paper by Cheetham and Inett, 1953[1].) Furthermore, there is a greater angular distance between successive blows and this combined with the reduced impact energy leaves ridges at the base of the hole, which also curtail speeds.

Had drilling tests been taken much beyond 100-ft level it is possible that rotation would soon have been completely eliminated and so the drill would have stalled.

Of the two bit types, the cross is known to possess greater lasting qualities and this is well illustrated in this particular instance. Cutting corners were still well preserved after 100 ft of drilling. In all probability, the cross bit would stall while still operating at a penetration rate higher than that at which the chisel bit stalled.

Analysis of cuttings collected from these tests showed that cross bit produces more new surface area per 100 gm of product and also per minute of drilling than does chisel bit of same diameter. That is, smaller overall debris product is formed at all thrusts.

This may be due to difference in linear advance per revolution produced by the two bit types. Since base of hole is removed in very approximate ratio of two slices to one, it appears inevitable that the bit with less penetration per blow will produce smaller debris size. Thus, it is almost inevitable that the faster cross bit produces the greatest over-all total product, not only in weight but also in surface area, per unit drilling time.

Work of Hartman and Pfleider, 1955,[3] however, does not agree with this result. Although, as they say, it may not be possible to generalize on this matter. They claim that rock type and rifle-bar rotation must have some effect on ultimate debris size, and probably a difference in cutting action as well.

Grateful acknowledgement is made to the Institution of Mining and Metallurgy, England, for permission to reproduce rig photo and the substance of Table II.

Any opinions expressed are the author's and do not necessarily reflect any official viewpoints.

References

[1] Cheetham W. R. and Inett E. W. (1953), Trans. Inst. Min. Metall. 63, 1953-54, 45.
[2] Innett E. W. (1956), Mine and Quarry Eng. 22, No. 7, 1956, 274.
[3] Hartman H. L. and Pfleider E. P. (1955), Mining Eng. Special Report No. 1, Trans. T. P. 4005. A. 1955.

Can Flotation Rates Be Improved?

W. R. HORST
T. M. MORRIS

FLOTATION MEN MAY BE MISSING A GOOD BET in not classifying feed into several size ranges and treating each size at different impeller speeds and air volume input to obtain the optimum over-all recovery rate. This is pointed up by experiments conducted in the laboratory at Missouri School of Mines & Metallurgy which indicate how variations in flotation rate are dependent on the combination of impeller speed and air volume used.

In a flotation operation, as in every beneficiation operation, two objectives are sought: the highest grade of concentrate possible with the maximum recovery of valuable solid.

The froth overflowing the head cell in a bank of flotation cells does not contain much gangue, while froth from succeeding cells contain progressively more gangue. Therefore in order to obtain the highest grade of concentrate, it is desirable to decrease the time of flotation. To do this, and at the same time obtain maximum recovery, the flotation rate must be increased. Therefore it is important to investigate how the flotation rate is affected by flotation variables such as collector, frother, conditioners and also size of particles to be floated, speed of impeller and volume of air input. Other variables are types of impellers, depth of flotation cell, etc.

In this investigation we are concerned with effect of two of these variables, impeller speed and air volume, on the flotation rate of various sizes of particles. This type of information would be important in determining the air volume-impeller speed combinations required for the optimum flotation rate.

Measurement of the flotation rate has been considered by many investigators[1, 2, 3, 4] and their methods of expressing the flotation rate have varied. In comparing flotation rates, it is more satisfactory to compare straight lines than the exponential curves which result from plotting cumulative recovery versus cumulative flotation time.

Equations of first, second and three-halves order rates were tried to evaluate the experimental results. Since the three-halves order rate equation fits the experimental results best, it was chosen to evaluate the flotation rate. It must be remembered that evaluating the flotation rate is the important factor, and no attempt is made to establish the order of the reaction since the exact mechanism is not known.

The rate equation for the three-halves order reaction may be expressed as

$$\frac{dx}{dt} = K\,(A-x)^{1.5} \quad \text{(Eq. 1)}$$

where x = cumulative percentage recovery of floatable particles after time t
A = initial percentage of floatable particles
t = flotation time
K = a constant, flotation rate constant.

Integration of Equation 1 gives the equation

$$\frac{1}{(A-x)^{\frac{1}{2}}} = \frac{K\,t}{2} + \frac{1}{A^{\frac{1}{2}}} \quad \text{(Eq. 2)}$$

By plotting $1/(A-x)^{1/2}$ versus the flotation time, t, the flotation rate constant, K can be determined since it will be equal to twice the slope of the resulting line.

Experimental procedure, data, and results are shown on pp 82 and 83.

Experimental Results

Experimental results indicate that:

The flotation rate constant was a maximum in the range between 39 and 60 microns and decreased as the particle size decreased or increased. (See Fig. 1 through 5.)

Effectiveness of increased impeller speed is retarded if the air volume is inadequate. (See Fig. 1 and 2.)

Flotation rate vs particle size curves increase in magnitude as the impeller speed increases. However, at impeller speeds in 1,725 rpm (Fig. 1) and 2,048 (Fig. 2), the magnitude of the curves decreases. Fig. 2, and 5 indicate that the air volume was adequate to yield beneficial results from the various impeller speeds as the over-all curves generally increased as the impeller speeds increased.

When using an impeller speed of 863 rpm, a change of air volume did not noticeably alter the respective flotation rate constants for the various particle sizes until the air volume was 3.5 liters per minute (Table IV).

At impeller speeds of 1,294, 1,725 and 2,048 rpm (Table IV), the respective flotation rate constants in regard to particle size increase as the air volume increases or levels off at the higher air input levels.

Other investigators[7, 8, 9, 10] have determined that flotation rate varies with particle size. The results of this investigation indicate that the variation in rate is dependent on the impeller speed-air volume combination used.

There are two major factors involved in removing the valuable minerals from a flotation cell in the form of a froth. Factor one—the solid and bubble must unite. Factor two—the bubble-solid aggregate must be capable of reaching the surface of the pulp without being disrupted. An additional factor is that the particle must remain in the froth long enough to be removed from the cell.

It is impossible at present to try to correlate these factors in the form of a mathematical relationship. About all that can be done is to point out qualitatively the effect of these factors under varying conditions upon the flotation rate constant for various particle sizes. Thus it would be expected that when a high enough impeller speed is usd to insure creation of many bubbles, the flotation rate constant would increase with air input. However, it may be that at large values of air input an excess of large bubbles are present and tend to disrupt the bubble-particle aggregate, as suggested by Sun.[11] Experimental results showed that excessive air volume or impeller speed was not beneficial for increasing the flotation rate.

What This Means to the Mill Man

From a practical viewpoint the results of this investigation indicate that for each size range of particles to be floated, a certain combination of impeller speed and air volume input gave the optimum flotation rate. The best combination would have to be obtained by experimental procedures. High air volumes are not desirable because of the carry over of gangue particles. Higher impeller speeds are not desirable because of increased power and wear. Hence high flotation rates found at moderate air and speed would generally be the most attractive economically; for example the high over-all 11 rate for 1,294 rpm at 2.5 and 3.0 liters of air, Table IV.

This experimental work suggests that it might be desirable to classify flotation feed into various size ranges

Mr. Horst is a metallurgical engineer in the Research and Development Dept., Foote Mineral Co., Berwyn, Pa. Prof. Morris is in the Metallurgical Dept., Missouri School of Mines, Rolla, Mo.

How the flotation tests were run and the results

I. Flotation Feed for Each Run

Constituent	Quantity
Pyrite-pyrrhotite (conc.)	75gm
Distilled water	700cc
Sulphuric acid (conc.)	0.2cc
Potassium ethyl xanthate	37mg
Terpineol	10mg

II. Observed Data from Four Runs Having the Same Air Volume and Impeller Speed

Impeller speed—2,048 rpm. Air volume —2.5 liters per minute

Test 2-3

Run	1	2	3	4
Grams of solids in froth after				
20 sec	18.3	20.8	19.7	20.2
40 sec	10.4	10.8	15.0	11.6
60 sec	7.5	9.4	8.2	10.3
90 sec	7.3	8.8	7.2	8.0
150 sec	10.0	8.2	6.4	7.1
Tailings	19.8	15.5	16.7	16.2
Sum	73.3	73.5	73.2	73.4
K [1 (min.) (per cent)]	0.066	0.089	0.086	0.085

III. Size Distribution of Particles in Froth

Test 1-4 Impeller speed—1,725 rpm Air volume—3.0 liters per minute

Mean diameter (microns)	Grams of solids in froth after 20 sec	40 sec	60 sec	90 sec	150 sec	Gm solids in tails	Totals
252	0.10	0.05	0.04	0.07	0.25	13.30	13.82
178	1.42	0.72	0.55	0.85	1.93	14.16	19.66
126	4.01	2.03	1.52	1.96	2.96	7.52	20.03
89	6.22	2.96	2.23	2.37	2.97	5.86	22.63
60	23.05	10.83	8.13	7.46	8.00	13.30	70.78
39	7.15	4.25	2.77	2.91	2.33	5.06	24.48
27.5	4.07	2.69	1.91	1.90	1.76	3.66	16.02
19.5	3.10	2.26	1.20	1.95	1.80	2.65	12.99
13 8	1.73	1.32	0.97	0.97	0.90	1.90	7.80
9.8	0.50	0.56	0.21	0.23	0.33	0.54	2.39
−8	0.44	0.32	0.18	0.23	0.24	0.40	1.85
Sum	51.83	28.04	19.76	20.93	23.52	68.38	212.48
Original gm of froth	53.50	28.64	21.00	21.25	24.32	70.11	218.84

Experimental Procedure

Pyrite-pyrrhotite concentrates prepared from Tennessee Copper Co. ore[5] were used in the experiments. The flotation tests were made using a 250-gram mechanical type flotation machine similar to the one described by W. F. Dietrich[6] et al. The flotation feed for each run is tabulated in Table I. Four runs were made having the same air volume and impeller speed, and the three runs having the most similar flotation rate constants were combined to make one test. This was necessary in order to have a sufficient amount of solids in each froth prior to sizing.

An example of the data collected from a series of four runs is shown in Table II. On the basis of the flotation rate constant, K, runs 2, b and 4 were combined to make Test 2-3. That is, the frothers from the respective time intervals were combined, and likewise the tailings.

Twenty tests were made varying the volume of air and impeller speed. The impeller speed varied from 863 to 2,048 rpm and the air volume varied from 1.0 to 3.5 liters per minute. The data from Test 1-4, which are representative of the data from the twenty experimental tests, are shown Table III. Flotation rate constants for all of the size fractions for each test appear in Table IV. Results of the 20 tests made are illustrated in the sets of curves on p 83.

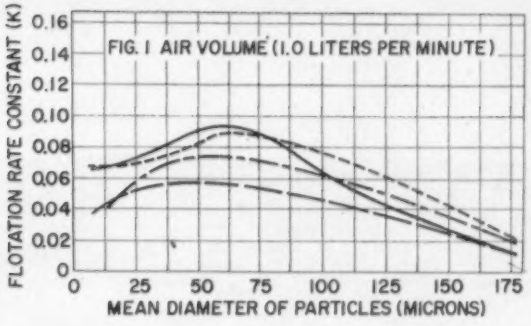
IV. Flotation Rate Constants for 20 Tests

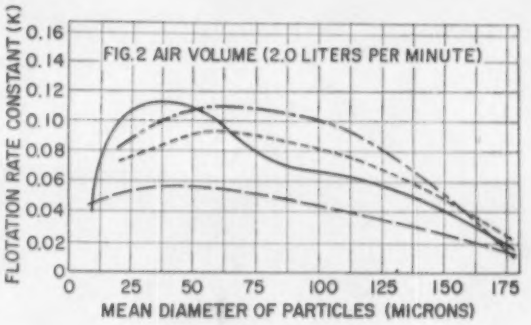
Flotation rate constant, K [1/(min.) (per cent)]

Mean diameter (microns)	Air volume (liters per minute) 1.0	2.0	2.5	3.0	3.5
Impeller speed—863 rpm					
over-all	0.04	0.04	0.04	0.04	0.07
178.0	0.01	0.01	0.01	0.00	0.01
126.0	0.03	0.03	0.03	0.03	0.04*
89.0	0.04	0.04	0.04	0.04	0.07
60.0	0.04	0.05	0.05	0.05	0.12**
39.0	0.05	0.05	0.05	0.06	0.13**
27.5	0.05	0.05	0.05	0.05	0.11
19.5	0.04	0.05	0.05	0.05	0.10
13.8	0.04	0.05	0.05	0.05	0.10
9.8	0.03	0.04	0.06	0.06	0.07
Impeller speed—1,294 rpm					
over-all	0.06	0.07	0.08	0.08	0.09*
178.0	0.02	0.02	0.01	0.01	0.02
126.0	0.06	0.07	0.06	0.06	0.07
89.0	0.08	0.08	0.09	0.09	0.11
60.0	0.09	0.09	0.10	0.10	....
39.0	0.07	0.08	0.10	0.11	0.12
27.5	0.07	0.07	0.09	0.10	0.09
19.5	0.07	0.07	0.08	0.09	0.09
13.8	0.06	0.07	0.07	0.12	0.10
9.8	0.07	0.07	0.06**	0.11	0.11*
Impeller speed—1,725 rpm					
over-all	0.06	0.07*	0.08	0.07	0.09*
178.0	0.01	0.01	0.01	0.01	0.01
126.0	0.04	0.06*	0.06	0.05	0.06
89.0	0.07	0.07	0.09	0.08	0.11
60.0	0.09	0.10**	0.12*	0.11	0.11**
39.0	0.08	0.11	0.16	0.11	0.15
27.5	0.07	0.11	0.11	0.09	0.15
19.5	0.07	0.09	0.09	0.09	0.11
13.8	0.07	0.08	0.09	0.09	0.12*
9.8	0.06**	0.04	0.08	0.09	0.12*
Impeller speed—2,048 rpm					
over-all	0.05	0.08	0.10	0.08	0.11
178.0	0.01	....	0.03*	0.03*	0.03*
126.0	0.05	0.08	0.10*	0.07	0.10
89.0	0.06	0.10	0.12	0.11	0.14
60.0	0.07	0.11	0.12	0.13	0.15
39.0	0.07	0.10	0.13	0.08	0.14
27.5	0.06	0.09	0.12	0.10	0.13
19.5	0.05	0.08	0.10	0.09	0.12
13.8	0.04	0.10	0.10	0.08*	0.14
9.8	0.09	0.11	0.10	0.09	0.13

*Having actual and theoretical recoveries differing by more than 3% at two points.

**Having actual and theoretical recoveries differing by more than 3% at three points.





How Flotation Rate Varies

These curves show the variation in flotation rate with particle size at different impeller speeds and with different volumes of air being introduced. Flotation rate constant (K) is plotted as $\frac{1}{t(A-x)^{\frac{1}{2}}}$ where

t = flotation time

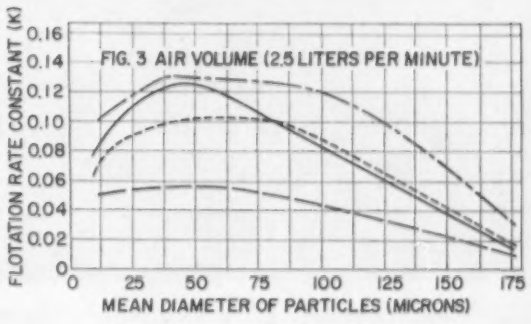
A = initial percentage of floatable particles

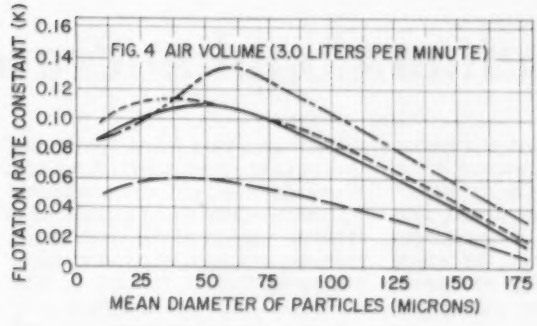
x = cumulative percentage recovery of floatable particles after time, t

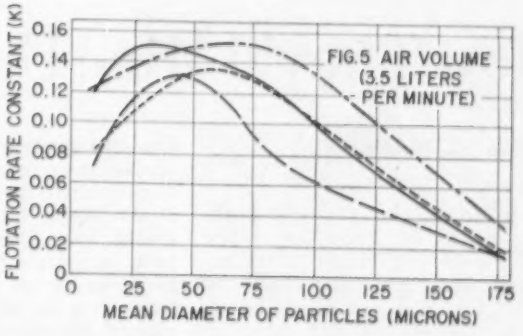
Each figure is for a different volume of air. Different impeller speeds are indicated as follows:

863 rpm — — — — 1725 rpm ————

1294 rpm ---------- 2048 rpm - ·— · —







and float each range at the impeller speed and air volume input which gave the highest flotation rate constant for that range. Use Fig. 4 as an example and divide it into three size ranges. Let the first range be from 0 to 30 microns and the impeller speed be 1,294 rpm. Let the second range be from 30 to 60 microns at 1,725 rpm, and let the third range be from 60 microns upward at 2,048 rpm. Over-all flotation rate would be about 0.11 for the minus 100 micron solids which represents about 80% of the feed.

Compare this with the over-all flotation rate constant for the 1294 rpm test of 0.080, as shown in Table IX, or of 0.070 for 1,725 rpm and 0.085 for the 2,048 rpm test. Each size group must be investigated in order to determine the best combination of impeller speed and air volume input to give the optimum flotation rate.

Where it would be desirable to classify flotation feed into size ranges, the over-all flotation rate might be increased by operating groups of cells in a bank of cells under varying conditions of impeller speed and air volume input.

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Mill Construction, Like Denison's Huge 5700-tpd Unit, Hints At The Scope Of

How They'll Mine Uranium Conglomerate

JAMES W. FRANKLIN

BLIND RIVER, ONTARIO, HAS COME ALIVE with the excitement, activity and orderly confusion created by the development of 11 uranium mines and construction of at least 8 mills in one rather small isolated area about 10 miles from the town. That's why it got the name Blind River. Perhaps a better name would be the one the companies prefer—the Algoma Basin.

The town itself, has doubled in population since word leaked out that uranium had been found; and in the next five years, more than $650-million will be expended there in labor and operating costs alone.

So far more than $985-million in precipitate contracts have been signed with Eldorado Mining & Refining, Ltd., the Canadian Government buyer. These contracts, with the eight mining companies discussed below, cover a 5-year period. And, up to now, most of the concentrate has been resold to the U. S.

Uranium is found in conglomerate reefs, mainly in the basal conglomerate that rests on pre-Huronian granite. Contact between sediment and granite appears at or near the surface in the shape of a rough Z. The upper and middle limbs form a trough, the Quirke Lake Trough. This plunges west and sediments lie in the trough as shown above. Middle and lower limbs form an anticline with granite exposed between them.

Uranium values are found near the contact between the sedimentary rocks and the granite; on the contact in some places; as high as 120 ft above the contact in other places.

Pronto is the only property on the south limb, with most of the uranium-bearing sediments appearing on the north and south flanks of the Quirke Lake Trough.

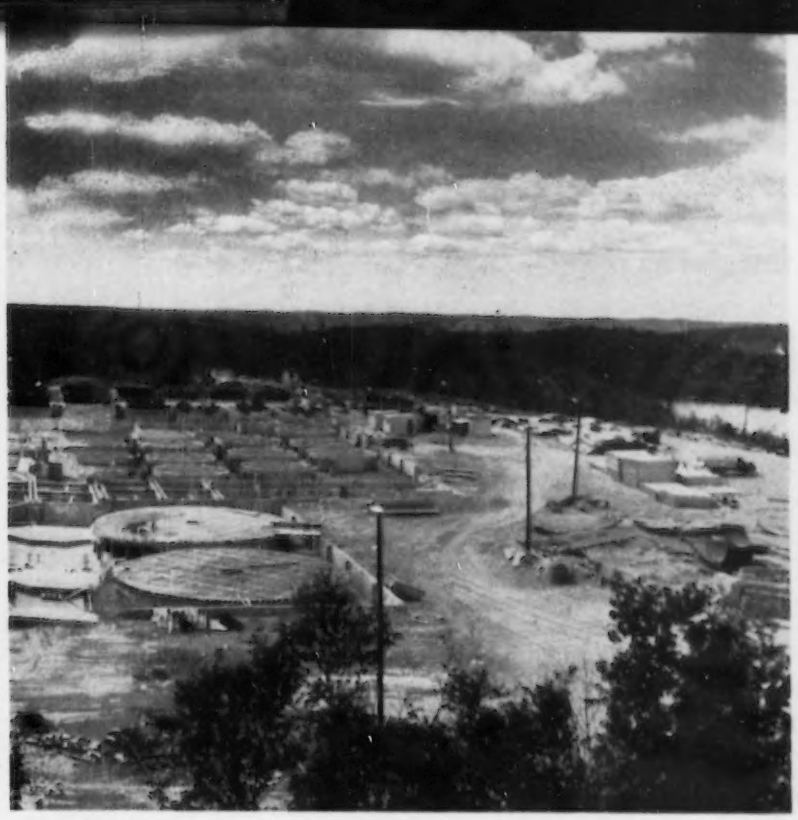
Down-the-shaft rock sequence generally runs—granite, diabase, quartzite, upper and middle Mississagi quartzite, lower Mississagi with conglomerate bands, basal conglomerate, then pre-Huronian argillite, greenstone and granites. Mississagi formation is about 275-ft thick, shows radioactive conglomerate scattered in thin bands or thick reefs in the lower 50 ft.

At Pronto Uranium Mines Ltd., there is some faulting, usually not more than 6 to 8 ft. At Nordic and Quirke Lake, there appears to be little or no faulting, and the ore-bearing reefs show widths to 30 ft. This conglomerate is tough to drill, with quartz pebbles averaging 1½ in. in diameter making up 50% of the reef. In most cases, more than one reef occurs.

Pronto, the early-bird and only one on the south limb of the Z, next to Queen's Highway 17, has been on-stream since last September 1955. Within months from now, Algom Uranium's Quirke (north limb) and Nordic (center) will be in production. Denison (north limb) will follow, with Northspan, Can-Met, Stancan, Stanleigh and Milliken Lake coming later.

Headframes and mill buildings are springing up everywhere in an area that only four years ago boasted of only one fishing lodge. According to W. J. Bennett, president, Eldorado, in *Western Miner & Oil Review*, July 1956—Gross annual income from uranium mining in Canada will pass the $300-million mark by 1958.

And speaking of the *Western Miner*, we'd like to congratulate the editors for their excellent coverage of the Algoma Basin in their July issue.



Developments as Canada's Engineers Decide . . .

In The Algoma Basin

In 1958, Canada will be turning out some 44,000 tpd uranium ore from 24 mines. Eleven of these mines will be in the Algoma Basin and will deliver more than 34,000 tpd.

How will they mine this conglomerate that is so often compared to the Witwatersrand? Will they all use the same methods? What determines mining scheme? What equipment will they use? We went to Blind River and then out to the Algoma Basin to find the answers to these questions.

This tremendous, widespread and low-grade deposit has been called a second Rand. Algoma differs in that it is very low in gold, has wider reefs and probably will be easier to mine. Mining ore grade is practically uniform, not varying more than a ½ lb from one mine to the next. And none of it runs more than 0.1% U_3O_8.

Further indications as to the size of this deposit can be gained by considering Pronto, the smallest tonnage producer in the area. In the next two years, Pronto will mine and mill tonnage equal to that reported in Charles A. Steen's famous Mi Vida. Of course, Algoma ore is lower grade and mining costs may be a little higher.

Two basic methods are being used, best typified by Pronto's shallow and steeply pitching reefs, and Denison's deep, wide, moderately dipping beds. Where the reefs are shallow and under 10-ft wide, open stoping without timbering and sometimes without backfilling is being used. When the ore lies deep and runs better than 10-ft wide, modified room and pillar with trackless equipment will be used.

Most companies are sinking two shafts, because they want to use diesel-powered trackless equipment. To comply with Canada's strict mining law on ventilation, two connected shafts are necessary before such equipment can be used. At mines where only one shaft was sunk, ventilation raises were driven to surface from working levels alongside the orebody.

Here's a company by company survey of current doings, mining plans and equipment demands.

Pronto Uses Open Stoping

With a $55-million precipitate contract, Pronto has been producing for about a year. Total reserves blocked out, before Eldorado contract, in two separate groups of claims (about two miles apart) have been reported to be worth more than $60-million at today's prices. They spent some $7-million to develop and build this 1200-tpd mine and mill.

Mining method is long-wall retreat in open-stopes, since the hanging and footwall are sharply defined and the hanging wall stays put. We saw only one spot in the mine that needed timber. At first, during exploration and development, they drifted through the ore. Now that they have a good surface stockpile, they drive in the footwall, about 20 ft below the ore. The shaft passes through ore at 230 ft and bottoms at 592.

According to Paul E. Young, manager, they have five stopes working, five developing and two on clean-up. Ore is mined on three levels. Stopes are started by driving up a central box hole from the sub level, 20 ft under the ore. Originally, according to our escort, Paul Park, research and safety supervisor, Pronto used one box hole in each half of the stope. But they found that a central hole was better, since one slusher could muck out both sides of the stope.

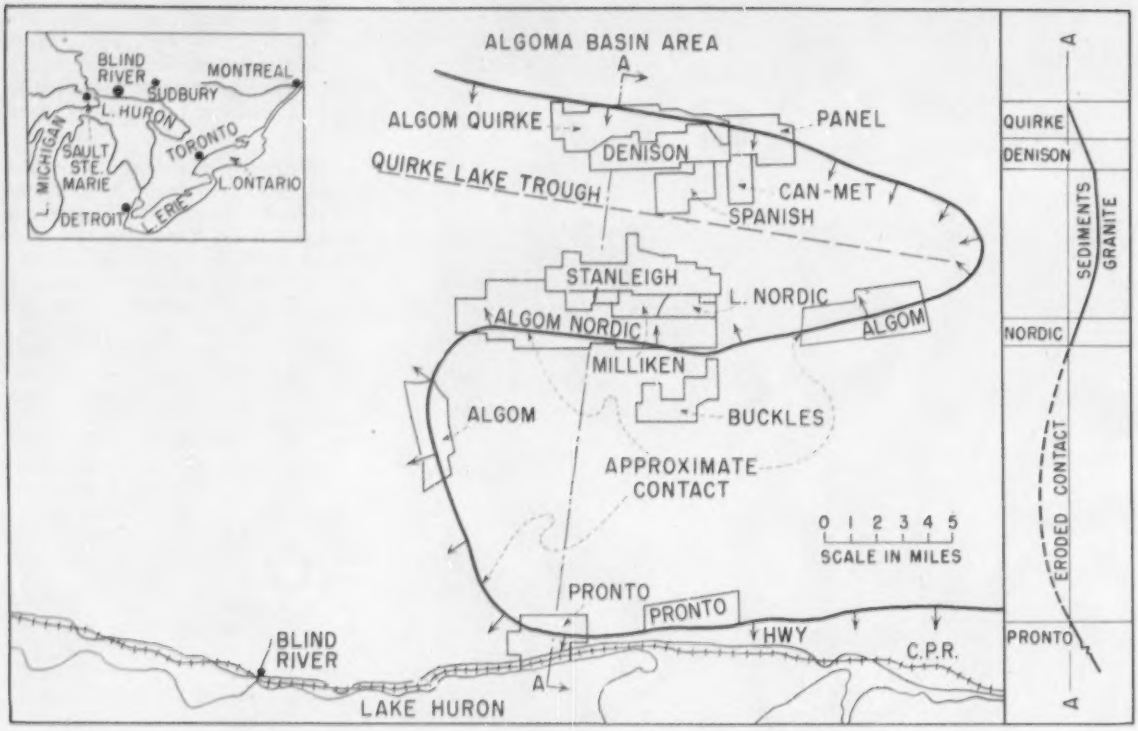
From the box hole, they drive a raise up the center, slushing on the sub level at the same time. Stopes are 160 ft wide with an 18-ft pillar on each side and an 8-ft pillar in the center. This temporary 8-footer is pulled if possible when the stope is cleaned out.

Stopes range from 180 to 240 ft long and ore runs 5 to 13 ft thick. When the raise is pushed the height of the stope, they start taking alternate right and left hand 10-ft slices. While one side of the stope is being drilled, the other is being mucked out.

Powder factor in development work averages 11 lb per ft advance. While in stoping, powder consumption runs ½ to ¾ lb per ton broken. Under the guiding eye of Jock Brander, chief geologist and Harold Pudney, bonus engineer, a close watch is maintained on ore width and grade. Ore tends to be low grade in the hanging wall side and the reefs show occasional faulting from 1 to 8 ft. This radioactive conglomerate runs high in quartz pebble, which makes for difficult drilling. Ore assays up to 15% pyrite, with uranium as brannerite occurring around the surface of the barren pebble and in the pyrite.

Equipment being used to mine 1200 tpd, as pointed out by Eric Holt, chief engineer, includes the following:

Drills — Canadian Ingersoll-Rand (CIR), JR-38 and Gardner-Denver FL-58 air legs fitted with Atlas Vibresist, ⅞th-in. hex steel, in 5 and 10's. Bits include Canadian Ingersoll-Rand ZLU, tapered tungsten carbide.



Most Of The Ore's In The Quirke Lake Trough

Loader—Eimco 21-B, then to 3-ton cars hauled by 1½-ton Atlas electric locomotive in development headings.

Slushers and scrapers—CIR 2-drum, 20 hp and 3-drum, 30 hp; Joy 2-drum, 15 hp and 3-drum, 25 hp; and Picrose 2-drum, 20 hp and 3-drum 30 hp. Scrapers are Pacific and Armco with 48- or 42-in. blades.

Ore cars—Granby 3-ton, six to a train, drawn by Atlas 4-ton electric.

Communications — scund power phones.

Hoist—CIR double drum with more than 2,000-tpd capacity.

Shaft—Three compartment to 592 ft.

Denison to Use Room & Pillar

Consolidated Denison Mines Ltd. will have the largest single unit uranium mine and mill in the world. Two large shafts are going down, one of which is now completed and a 5700-tpd mill is going up.

The uranium-bearing, pyritized conglomerate bed was cut at 1,580 ft in No. 1 shaft which was sunk on to 1,856 ft to provide for an ore pass and sump. The 55-ft wooden headframe has now been replaced by the steel permanent unit. No. 2 shaft, located one half mile south of No. 1 shaft, is presently being sunk and will intersect the ore at approximately 2500 ft. The dip of the ore bed, as outlined by diamond drilling averages 19 dcg.

Ore reserves are now well in excess of the tonnage used as a basis for contract negotiations with Eldorado which calls for delivery of $182.25-million of uranium in precipitate. The drilled off area covers only a small portion of the 88-claim, 3900-acre property.

Mining method is a modified room and pillar, similar to some used in large operations in the U. S. We saw large trackless, electric and air operated equipment which we understand is now in use underground. They will connect No. 1 and No. 2 shafts with a five-entry panel, main artery to provide for all essential mine services. Initial development and mining will be done from No. 1 shaft. After the incline is driven they'll install a conveyor belt to direct the flow of the ore to the No. 2 shaft area for hoisting and crushing.

The main orebed varies from 10 to 32 feet in thickness. A second bed, which lies 150 feet above the main, will probably be mined at a later date. It is planned to dieselize mobile equipment as soon as ventilation will permit.

Equipment presently in use at this operation, includes:

Drills—Joy 4-boom, tire mounted for template drilling. Steel is 1⅛-in. diameter alloy wtih tungsten carbide.

Loaders — a specially designed Rogers Iron Works, crawler-mounted loading ramp with 30 or 40 hp Joy slusher-hoists.

Cars—Joy 14 RC, shuttle-cars, tire-mounted, 4-wheel drive. Designed for climbing 35% grades, fully loaded.

Shaft Muckers — Cryderman and cable clam type.

Hoists—Three 12-ft diameter Ingersoll-Rand and one 6-ft diameter Ingersoll-Rand.

Compressors—4 XVH-3300 CFM Ingersoll-Rand.

Shafts — No. 1 — 5-compartment, bottomed at 1,856 ft. Now used to develop the mine, will later serve as a second exit and will be used for ventilation, service and increased production.

No. 2—7-compartment, now being sunk to a projected depth of about 2,800 ft, will be used as a main production shaft.

Two Mines, Two Methods at Algom

Algom Uranium Mines Ltd. holds 634 claims in the area. These claims are in four separate groups, two of which, Algom Quirke and Algom Nordic are being prepared for production at 3,000 tpd each. Algom has a contract with Eldorado to sell $206.91-

million in precipitate. Plans are to have Quirke in production in October and Nordic by December.

R. C. Hart, manager, controls all operations through a central staff, with a property superintendent and a staff at each mine. The central staff coordinates warehousing, purchasing, accounting, employment, mechanical and electrical engineering and research.

Rocks in the area are a series of old metamorphosed sediments forming a gently west-dipping synclinal trough. The ore is a quartz-pebble conglomerate from 8 to 15 ft in thickness, interbanded with quartzite in the lower part.

At Quirke and Nordic, ore characteristic is similar, but its attitude varies. Quirke is on the north side of the syncline, where sediments dip south at from 25 to 40 deg and Nordic is on the south side, where sediments dip north at from 15 to 30 deg. Thus, mining methods are different at each property.

Mining method at Quirke is conventional track-haulage. Drifts are driven in ore for development and mining purposes. The main haulage drift is on the 6th level, about 150 ft in the footwall under and connected to stopes on upper levels by collecting raises. Stoping will be laid out in 300-ft panels. Sections, 50 to 60 ft in strike length, will be taken up dip and open stoped, scraped clean and backfilled with sands from mill tails.

Mining method at Nordic will be completely trackless, due to flatter dip. All drifts are driven in the ore. A sub-drift is driven by ramping up the footwall and it is from this sub-drift that stoping will start. Stopes will be driven as a face 50 to 100 ft long from the sub to the level above. Then, ore will be gathered with scrapers, loaded with Eimco 630's or Joy Loaders into Dumptors or Shuttlecars.

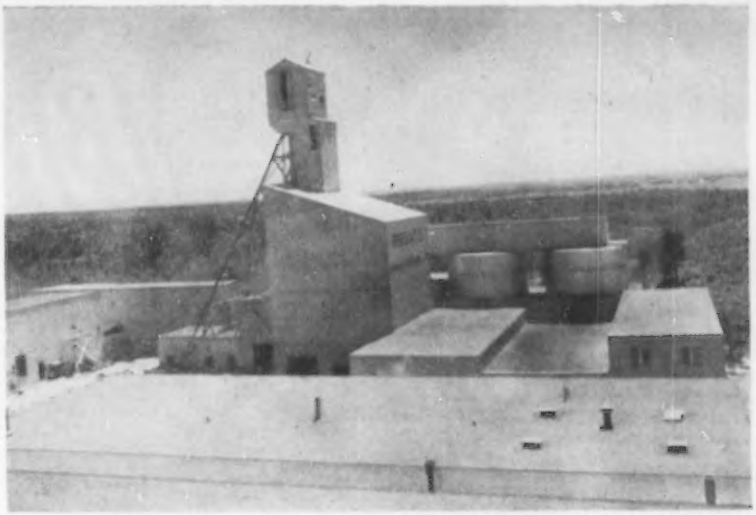
In both operations, every attempt is made to standardize and use similar equipment.

Hoists—Two in each shaft: man-cage and skip. They are CIR, double drum, wound with 1½-in. flattened strand rope. Man-cage has 350 hp motor and ore skip has 600 hp. The man-cage is designed to transport 30 men or a maximum load of 12,000 lb. Two, 7-ton bottom dump, steel skips running in balance, hoist ore or waste from loading pocket to bins in headframe.

Shafts—One at each mine. 5-compartment: two skip, one man-cage, counterweight and manway .

Three Made Into One

Northspan Uranium Mines Ltd., subsidiary of Rio Tinto, is the amalgamation of Panel Consolidated Ura-



ON-STREAM FOR A YEAR, Pronto uses open stoping to recover 1200 tpd from steeply pitching reefs. Mill is in foreground with crusher house in background.

CRUSHING WILL BE DONE on the surface near Consolidated Denison's No. 2 shaft in the crusher house going up to the left of Mike Steele, safety supervisor.

USING DRILL JUMBOS, like this Joy 4-boom, Denison will break ore in room and pillar at 5700 tpd, according to Mario deBastiani, assistant mine manager.

DENISON USED this Rogers Iron Works loading ramp to muck out a ventilation incline down to the first level. It was designed for loading diesel trucks underground.

nium Mines, Lake Nordic Uranium Mines and Spanish American Mines Ltd. Their combined contract with Eldorado calls for mining and milling some 9,000 tpd and to deliver $242,-416-million in precipitate.

This 9,000 tons is distributed among the three as follows: 4,000 to Lake Nordic, 2,000 to Spanish American and 3,000 to Panel. They haven't announced where they will build the mill or mills.

Panel has two shafts going down. No. 1 is on an island in Quirke Lake, connected to the mainland by a causeway. Shaft will go down to 1,000 ft, having passed 600 ft at present time. No. 2 is down dip on a second small island. This one will bottom at 1,250 ft. It's down through 500 now.

Mining method will be modified trackless system.

Equipment is not on hand as yet. Some has been ordered for development where Jumbos will be used, assisted by overhead loaders.

Spanish American joins Denison on the north and they also own the Buckles property near Algom Nordic's south flank. The smaller Buckles deposit will be mined first. Here ore dips 18 deg and averages 11 ft in thickness. Buckles shaft will bottom at 225 ft and all production will come from the 120 level.

Mining method will be a modified trackless system.

Equipment is being ordered, like that at Panel.

At the main Spanish American property, next to Denison, they'll have two shafts, about 800 ft apart. Both are down below 1,200 ft, will pass through ore at 3,200.

Mining method will be a modified trackless system.

Equipment being ordered parallels Panel and Buckles orders.

Sinking Hoist—CIR, model PE-1, 72-in., double drum, 500 hp at No. 1 shaft; and CIR, double drum, 60-in., 300 hp at No. 2.

Shaft—3-compartment, with wooden temporary headframe to 2,000 ft, then permanent will take over for final sinking.

Lake Nordic borders Milliken on the west and Algom Nordic on the south. Property covers some 29 mining claims and shows radioactive conglomerate in two reefs, each averaging 11 ft thick and about 14 ft apart. No. 1 shaft will go down to 2,700 ft. No. 2 will go to 2,550. Both shafts are below 1,400 ft, should bottom by January.

Mining method will be room and pillar with diesel equipment after No. 1 and 2 have been connected by ventilation incline. Ore will be mined from both reefs, which dip 17 deg N, in this modified trackless system.

Equipment being ordered is same as that for other Northspan properties.

Sinking hoist—CIR, model PE-1, 60-in., double drum on 300 hp at No. 1; and No. 2 has CIR, model PE-1, 72-in., double drum on 500 hp.

Shaft mucker—Riddell.

Shaft—3-compartment to 525, and four below.

Four More Have Signed

Stancan Uranium Corp. has estimated 5-million tons blocked out so far and that figure may go as high as 20-million. They plan to mine and mill 3,000 tpd, and are negotiating a contract with Eldorado on that basis. They have two shafts going down with No. 1 passing ore at 3,000 ft and No. 2 at 2,750. No. 2 will be service shaft. Letter of intent was received from Eldorado for $76,359,360, according to the *Northern Miner*.

Mining method will parallel Denison's: room and pillar in a five entry system.

Stanleigh Uranium Mining Corp. has estimated 8- to 15-million tons, recently signed a $72,981-million contract with Eldorado. Mine and mill will treat 3,000 tpd. This company is considering erecting their own auxiliary facilities.

Ore runs in two reefs separated by 10 to 30 ft of low grade ore, with reefs averaging 10 ft in thickness. Two shafts are going down with plans to bottom No. 1 at 3,800 and No. 2 at 3,650 ft. Shafts will be bottomed by mid-1957.

Mining method is tentative; but they plan to use room and pillar, trackless method with conveyor ore transport. This is the deepest attempt in the area, and may be the deepest known for room and pillar mining.

Equipment is being decided upon by Pioneer Consultants Ltd., Haileybury, Ont., and Walter J. Fulmer of Stanleigh.

Can-Met Explorations Ltd. is sinking two shafts into an estimated 10-million ton orebody. No. 1 shaft will bottom at 2,200 ft, while No. 2 will go down to 2,500. They have a $75,852-million contract with Eldorado, plan to mine and mill 3,000 tpd. Both shafts are below 700 ft and they plan to start treating ore by May 1957.

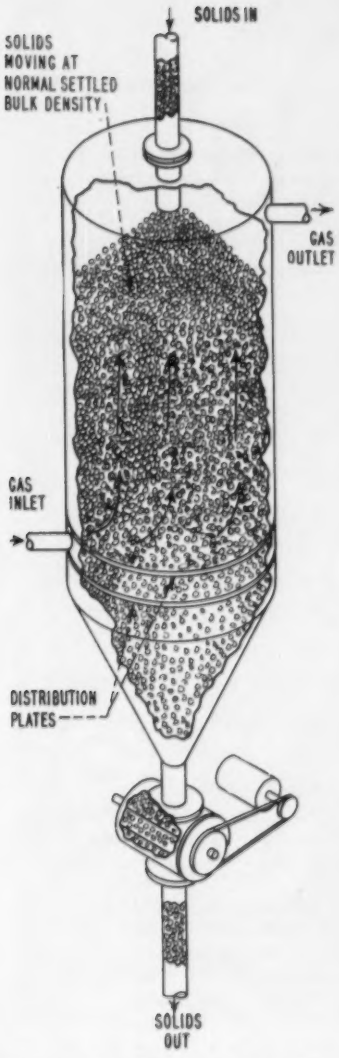
Mining method will be the same as Denison's.

Equipment to be used is similar to that indicated at Denison.

Milliken Lake Uranium Mines Ltd. is believed to have 12-million tons, with 20-million possible. Projecting ore trends through undrilled areas toward Algom Nordic and Lake Nordic, they may have close to 30-million. They're sinking two shafts to 3,200 ft, hoping to have the mill running by September 1957. Milliken has a freshly inked contract with Eldorado calling for delivery of $77,925-million in precipitate. But according to the *Northern Miner*, Sept. 6, 1956, shaft sinking and mill construction have been halted temporarily due to delay in financing the project.

Mining method is tentative, will probably be trackless.

Equipment has not been decided upon at this time.



A **MOVING-BED** is a mass of discrete particles moving downward (or upward) at normal, settled, bulk density, countercurrent or concurrent to the flow of fluid.

I The Unique Advantages of the Moving-Bed Technique

1. Simple provisions for concurrent or countercurrent flow with moving-bed units, easily permitting large number of stages. These can not be obtained in fluidized bed without excessive investment and complications of equipment design.
2. Versatility for handling a wide variety of solids.
3. Little or no problems of dust entrainment in effluent gas stream. This is a particularly serious problem with fluidized beds, involving complex and costly dust recovery equipment.
4. Reasonable pressure drops across the beds.
5. Simple provisions for establishing temperature gradients along the reactor to permit optimum conversions. This is very difficult if not impossible to obtain with fluidized solids except by use of reactors in series.
6. Ease of start-up and shut-down of operations.
7. Suitability for handling valuable or hazardous materials.
8. Provision for a wide range of retention time of solids in reactor.
9. Uniformity in residence time of catalyst.
10. Negligible erosion.
11. Readily adapted for elevated pressures.
12. Avoid problem of short-circuiting of feed to solids exit line.
13. Ease of feed preparation and simplicity of operation.
14. Large contact times attainable.
15. Simple solids recirculation.
16. Minimized attrition of solids.
17. Avoidance of excessive homogeneous phase reactions caused by high void fractions.
18. Flexibility of solid and gas flow rates and capacities.
19. Suitable temperature control by various heat transfer techniques.

. . . And the Limitations

1. Need for simple, efficient, economical feed preparation.
2. Relatively low heat transfer coefficients.
3. Limitations on handling fine powders because of restricted gas flows.
4. Necessity of assuring uniform distribution over entire cross section of solids and gas flows.

Moving-Bed Processes— Present and Potential Applications

RAYMOND E. VENER

AMONG OPERATIONS in the field of extractive metallurgy, none are more important or more widely used than those involving solids-gas contacting (See *E&MJ*, July 1956). Of these, some of the most versatile, efficient and economical operations are based on variations of the moving-bed technique.

To get a better picture of the technique, let's take a look at current commercial applications of the moving-bed process with the accent on the metallurgical field, and some of the potential applications. Finally, let's examine the component operations involved in engineering design.

Dr. Vener is a process engineer with the Catalytic Construction Co., Philadelphia, Pa.

I—Applications

To better evaluate the applicability of the moving-bed technique to metallurgical problems, let's review briefly commercial experience where many variations of the moving-bed technique have been designed for a wide variety of solids-gas contacting operations.

It is not possible to conceive of any known solids-gas contacting method as being completely satisfactory in all respects and universally applicable to commercial operations.

Similarly, it would be unreasonable to expect that any of the innumerable commercial solids-gas contacting operations can be conducted by only one method.

It is not intended either that the illustrations of moving-bed operations will necessarily prove more economical than all alternate methods or that the possible applications are limited to those cited. Preliminary cost estimates could readily be made for most of these processes but they would have little or no significance without comparable evaluations of alternate solids-gas contacting techniques. Table I outlines the general field of applications for moving-bed processes. Let's look at these classifications.

Solids Composition Is Unchanged

This category represents the most recent developments and refinements in the use of moving-beds, much of which could be used to excellent advantage in the metallurgical field. The outstanding application to reactions where the solid is either unchanged or regenerated is the catalytic cracking of petroleum hydrocarbons. Aside from this extremely important application, these new uses could prove interesting and noteworthy for the metallurgist.

Regeneration of Reactant. A report on a pilot-scale moving-bed operation was recently presented where solid pellets were chemically changed and subsequently regenerated into the original chemical state.

The process involved impregnation of inert particles with zinc oxide. The particles then react with ammonium sulphate in a reaction zone where SO_3 combines with ZnO to produce $ZnSO_4$. This releases gaseous water and ammonia. These gases were removed from the reaction zone while the inert solids (now impregnated with zinc sulphate) were decomposed thermally in the lower reactor to regenerate zinc oxide.

Oxides of sulphur were evolved and the regenerated zinc oxide recirculates to the top of the reactor.

Similar processes would be: the manufacture of hydrogen by reacting FeO with steam in a reactor with subsequent regeneration of the Fe_2O3 in a separate unit, and the return of FeO to the reactor; and the use of metal oxides as oxygen carriers to prepare pure SO_2 and carbon oxides without the need for nitrogen separation.

Numerous other schemes for producing hydrogen have been patented using various types of contactors. For many commercial operations it appears likely that fixed-bed units will be supplanted by continuous solids-recirculation methods.

Another possibility is the oxidation of ammonia to hydrazine hydrate using a moving-bed of reducible metal oxides. The oxides are re-oxidized in a second chamber and recycled to the first reactor.

A likely possibility is the separation of CO or oxygen from gas streams by passing them over solid compounds such as calcium manganite, calcium plumbate and manganese oxide, with subsequent regeneration of solids and release of gases.

Another suggestion is the fluorination of hydrocarbons with a moving-bed of CoF_3, with regeneration and recirculation of solids.

There are, of course, numerous other examples of applications involving the regeneration of solids which may be of interest in the metallurgical and chemical fields.

Heat Transfer. An application of the pebble heater originally developed for superheating steam, TPC is also used to preheat air for combustion and various chemical operations.

Additional possibilities that have

II Glossary

Attrition: Break up or wearing down of solid particles by abrasion, friction or impact.

Bridging: Obstruction or stoppage of solids flow in storage vessels and process equipment, brought about by interlocking or fusion of solid particles to form a span or "bridge" over the vessel or some part of the vessel.

Catalysis: The term applied to chemical process where the rate of chemical reaction is accelerated by the presence of a substance which is itself unchanged chemically in the process.

Conversion: Change of material from one physical or chemical form to another by one or more operations.

Diluent: An inert solid or liquid used to increase the bulk of some other substance or to dilute or diffuse the reacting constituent.

Disengager: Apparatus used to effect a separation of two phases.

Entrainment: Carryover of finely divided solids (or liquid droplets) suspended in a fluid (gas, vapor or liquid).

Fixed Bed: A settled bed of solids which is involved in some physical or chemcal operation, usually with a fluid (gas or liquid) flowing through the bed; e.g., fixed bed catalysis and ion exchange.

Fluidized Solids (Fluo-Solids): A finely divided solid material is said to be fluidized when it is suspended in either dense or dilute turbulent phase by an aerating gas or vapor, so that the suspension can be caused to flow like a liquid from a point of high level, pressure, or concentration to a lower point.

Heat Balance: A simplified form of an energy balance based on the law of conservation of energy (first law of thermodynamics). Of great practical value in process calculations, heat balances neglect differences of potential and kinetic energies, relative to the major heat effects of the entering and effluent streams.

Heat Transfer Coefficient: The rate at which heat is transferred per unit time, "q", is proportional to the surface area, "A", through which the transfer of heat occurs and to the temperature driving force, ΔT. The so-called heat transfer coefficient, U, converts this proportionality to an equality: $q = UA\Delta T$.

Glossary (Continued)

Kinetics: Also referred to as reaction kinetics or chemical kinetics, relates to the rate at which chemical reactions occur under given conditions.

Load: Indicative of quantity or capacity of a process or equipment; e.g., heat load on a heat exchanger, or pressure load of a pump.

Mass Transfer Coefficient: The rate at which mass is transferred per unit time, "N", is proportional to the surface area, "A", through which the mass transfer occurs and to the concentration driving force "$\triangle C$". The so-called mass transfer coefficient, K, converts this proportionality to an equality: $N = KA\triangle C$.

Meter Valve: Compartment, vane, or other types of positive displacement, rotary solids widely used for controlling or metering solids flow.

Moving Bed: A mass of discrete particles moving downward (or upward) at their normal, settled bulk density, countercurrent or concurrent to the flow of fluid (gas or liquid).

Phase Rule: Gibbs Phase Rule. A mathematical generalization of the relations existing between systems in equilibrium, which relates the number of phases, the variance or degrees of freedom, and the number of components.

Physical Chemistry: Concerned with the elucidation or clarification of the principles underlying those transformations of matter known as chemical reactions, through a study of the physical properties of the reacting substances and of the effect of physical changes on the reactions themselves.

Preforming: Preparation of a solid feed to a process or operation by one or more mechanical or chemical changes.

Reactors: Equipment in which all, or at least a major part, of a process, reaction or conversion takes place.

Recycle: Any material or stream which is returned to an operation for further processing.

Retention Time: Residence time of material within a given reactor or apparatus.

Yield: Proportion of product obtained from raw materials fed to a process or reaction; the percentage so obtained of that theoretically obtainable from quantity of one of the chemical compounds initially present.

been proposed for commercial applications are:

1. Heating of gases such as hydrogen and natural gas for the reduction of metallic oxides.

2. Production of high combustion temperatures in the field of refractories for continuous melting processes for the production of prefused grog in making brick and mortar.

3. Manufacture of fused cast refractories from materials that have been melted in a high-temperature combustion furnace.

4. Production of refractory mineral fibers by blowing a molten refractory stream with high-pressure steam or air.

5. Direct firing of ceramic ware. Patents have been issued on the use of pebble heaters for: vaporization of sulphur; removal of condensables from air at low temperatures; evaporation of black liquor in the paper industry with subsequent combustion of residue; desulphurization of hydrocarbons; the manufacture of CS_2 from carbon and sulphur heated by pebbles; and the production of ethylene and fuel gas by pyrolytic cracking of hydrocarbons.

The future should bring many new developments that incorporate this heat transfer concept in chemical and metallurgical operations.

Nonpetroleum Heterogeneous Catalytic Reactions. As a rule, most heterogeneous catalytic reactions that involve gas-phase conversions catalyzed by solids are conducted by fixed-bed methods.

In high-temperature organic reactions activated by solid catalysts, the conversion gradually declines due to catalyst fouling or deactivation. Where the catalyst can be used for only short periods without reprocessing or renewal and the heat effects are appreciable, a continuous moving-bed technique may have potential value for supplanting fixed-bed operations.

Particular attention should be directed at the selection of sound and practical processing schemes before estimating costs. Many processes can be ruled out after a very preliminary study. Conversely, some moving-bed applications which appear uneconomical may be based on arbitrary and unsound assumptions.

To approximate optimum conditions in a heterogeneous catalytic reaction, the control of temperature is often the most critical single problem in reactor design. Experience on a number of fundamentally different approaches is available:

1. Use fixed-bed adiabatic reactors with intermediate heat exchangers.

2. Add an inert constituent with high heat capacity to the reacting gas stream.

3. Mix inert solids that have high heat capacity with the catalyst to form pellets.

4. Inject reactants and diluents at various points along the reactor.

5. Remove heat by close contact of solids with heat transfer elements.

6. Integrate closely the reaction and regeneration to store and subsequently release the heat in short, cyclic operations.

7. Move the catalyst by moving-bed or fluidized-solids methods.

Catalytic reactions have assumed a tremendous importance in the petroleum and chemical fields. Over the past decade they have become increasingly important in the metallurgical field as well.

Solid Composition Is Changed

The applications of moving-bed techniques to reactions where the solids undergo permanent chemical change include many operations.

Shaft or vertical kilns involving moving-bed solids-gas contacting have been used for many years for production of pig iron, copper and lead. Here we find the earliest and, in terms of investment and capacity, still the most important applications of the moving-bed method in a field other than petroleum.

Operation of blast furnaces for pig iron—perhaps 100 ft high by 30 ft in diameter—is so well known that it

requires no detailed description here. The solid charge moves slowly down the shaft countercurrent to the gas stream. A series of complex heterogeneous reactions reduce the oxides of iron, subsequently fusing the entire mass to form molten metal and to form liquid slag.

Outstanding characteristic of the modern blast furnace is its phenomenal capacity and economy. Blast furnaces have also been used for the smelting of nickel, copper, lead and tin. Their main limitation has been the problem of handling finely divided material for which reverberatory furnaces are superior.

Blast Furnace Efficiency

However, the blast furnace has a much higher thermal efficiency than the reverberatory, uses a true countercurrent principle and is more suited for solids-gas contacting. The reverberatory is primarily a melting furnace. New, improved methods of feed preparation (discussed later) are the key to many problems mitigating against the use of moving-bed equipment. One such use is the handling of taconite fines.

The modern blast furnace, utilizing the moving-bed principle is widely acclaimed as an efficient shaft apparatus. Predictions have been made that current high rates in excess of 1,500 tons of pig iron per day can be doubled.

However, there is a growing sentiment to the effect that production rates cannot be economically increased merely by enlarging the size of furnaces. Many challenging papers have been presented questioning the classic type of design, particularly in view of critical changes in anticipated future feeds to these furnaces.

In other than metallurgical operations the most important application of the moving-bed technique to a nonpetroleum field has been the calcination of limestone. This is frequently done in a vertical or shaft kiln using the moving-bed principle. The lime shaft kiln consists of a steel stack lined with firebrick. The effluent gas may either be allowed to escape or be processed for carbon dioxide recovery.

Both moving-bed or shaft kilns and rotary furnaces are used for the production of lime by the calcination of limestone. In some cases the same company uses both types. The moving-bed unit is basically more efficient with respect to heat economy, flexibility, control, effective solids-gas contacting, true countercurrent flow and high concentration of CO_2.

Fluidized designs, involving multiple beds in an attempt to achieve countercurrent operation, have been proposed but they are inherently more costly, less efficient and more complicated than well-designed moving-bed units.

The major reason for the adoption of rotary calciners for capacities in excess of 100 tpd has been the difficulty in processing smaller particles and the apparent nonuniformity of the reaction in large cross-section shaft reactors.

In the ammonia-soda industry, modern moving-bed installations have been reported which are far smaller, yet they have capacities of over 300 tpd. Suitable feed preparation, better distribution of solids and gases and other improvements should circumvent the limitations cited above for shaft kilns.

Numerous designs of moving-bed or shaft furnaces are used extensively for gas producers and water-gas generators.

Moving-beds in the form of vertical shaft or stack kilns are widely used in Europe to manufacture portland cement. Rotary kilns are used in the U. S., but there has been considerable interest in the possibility of using vertical kilns incorporating new engineering improvements. Simplified and efficient performing or pelletizing of feed seems to be the key to possible use of moving-bed equipment for cement production in this country.

Portland cement is produced in moving-bed shaft kilns and rotary furnaces, by heating a mixture of limestone and clay (or material of similar composition) to the point of incipient fusion. This is an excellent illustration of the reaction of two or more solids to form new compounds.

Although considerable progress has been made in controlling the operation of shaft units to produce a uniform product of suitable quality, there is room for much improvement. However, it is possible that the replacement of rotary units by moving-bed shaft kilns can already be justified for smaller installations.

New or Improved Applications to Metallurgical Fields

Possible application of the moving-bed principle to metallurgical operations may be classified under the following categories:

1. Drying of solids.
2. Decomposition and volatilization by thermal means.
3. Reactions of gases with solids
4. Reactions of two or more solids.

Drying

The term "drying" used in this discussion is intended to comprise a broad category of operations that includes the removal of liquids from solids by thermal means, decomposition of inorganic compounds and ores containing chemically-bound water and the simultaneous removal of hydrogen plus hydroxyl groups from organic compounds. This terminology should also be considered applicable to similar operations involving solvents other than water.

The moving-bed technique should be considered as a general tool for carrying out such drying operations.

In many instances where the feed for a roasting or smelting operation consists of pelleted solids, the production units may function initially as dryers. The moving-bed principle can often be advantageously adapted for separate drying operations, especially if the subsequent roasting or smelting is conducted in some form of vertical shaft-type furnace.

Drying of pellets involves the heating and vaporization of water or other liquid in the interstices of the solid, or the decomposition of chemical compounds such as inorganic salt hydrates or complex ores. Possible rate-controlling mechanisms include: capillarity (due to surface tension effects); gravitational and frictional forces; vaporization within the pellets; and diffusion of vapor through the pores and through gas films about the pellets.

By varying conditions for a given system it is often possible to alter radicly the rate-controlling factor from one of diffusion to that of capillary forces.

Decomposition

There are many chemical decomposition reactions which are basically very similar to drying in terms of solids-gas contacting. They include: the decomposition of salts with chemically bound water, such as $Na_2SO_4 \cdot 10H_2O$; decomposition at elevated temperatures of complex compounds found in clays and ores involving release of chemically-bound water, CO_2 and other gases; decomposition or calcination of metal carbonates such as $CaCO_3$, $FeCO_3$ and $MNCO_3$; decomposition or roasting of metal sulphates ($ZnSO_4$), metal chlorides ($FeCl_3$), metal nitrate [$Mn(NO_3)_2$] and metal oxalates; and the removal of impurities by volatilizing certain oxides. such as SO_2, SO_3, As_2O_3, Sb_2O_3, TeO_2 and SeO_2.

In many metallurgical operations drying may precede a sulphatization or halogenation operation. The product from this may be leached to separate water-soluble constituents. This may be followed by a drying step and subsequent decomposition to produce metal oxides which, in turn, may be reduced to metal.

Many simplifications and economies

can be achieved by integrating two or more of these operations into one continuous moving-bed process.

There has been considerable interest in recent years in developing new processes for varied commercial metallurgical operations. Many of these processes involve the reaction of solids with gases and/or other solids. The advantages of incorporating many basically simple techniques into the design and operation of modern moving-bed kilns provide the most simple and economical—yet the most versatile—furnaces and kilns.

Among the special techniques that have been developed are: the use of heat absorbing elements (such as $CaCO_3$ and carbon) to maintain temperature levels; provisions for efficient use of heat; countercurrent and/or concurrent flow of reactant gases and solids; temperature control; extraneous heat removal or addition as required; use of sweep or inert gases; solid and gas distribution and separation; and elimination of dusting.

Many, if not all, of these and other operations can be shown to be technically feasible. Furthermore, the inherent advantages of the moving-bed process permit designs which in many cases should be more efficient and more economical than alternate solids-gas contacting methods.

Other Decomposition Reactions

Calcination of other materials that contain metal carbonates can also be carried out by moving-bed techniques. As in the decomposition of $CaCO_3$, it is necessary to keep the temperature of the reaction as low as possible to prevent fusion of silicates. This is related to a low partial pressure of CO_2.

A low partial pressure of CO_2 is readily obtained in a moving-bed operation by means of the countercurrent action. In some cases it may be desirable to mix carbon with the charge to lower the partial pressure of CO_2 by reacting with it to form CO.

There are additional fertile fields for application of moving-bed processes for drying or decomposition operations. These include the production of:

- Dolomite lime from either dolomitic limestone or from calcination of synthetic mixtures of magnesite and limestone.
- Magnesia from the calcination of either natural magnesite or from magnesite concentrates.
- Alumina from the dehydration of $Al(OH)_3$, the calcination of bauxite and clay for further chemical treatment and the calcination of plant residues.

III Classification of Moving-Bed Applications

Solids Composition is Unchanged

(1) Adsorption of gases on solids
(2) Regeneration of solid reactants
(3) Heat transfer
(4) Heterogeneous catalytic reactions

Solids Composition is Changed

(1) Decomposition or volatilization by thermal means with evolution of gases
(2) Reactions of gases with solids to produce new solid compounds
(3) Reactions of two or more solids to form new compounds
(4) Reactions of solids to form volatile compounds

Solids-Liquid Applications

(1) Continuous ion exchange
(2) Leaching
(3) Extraction
(4) Adsorption

- Borax from the decomposition of borates.
- Fuller's earth from the calcination of Fuller's earth clay.
- Refractories from the calcination of refractory clays to minimize shrinkage.
- Phosphates from the calcination of phosphate ores or concentrates.
- Manganese oxides from the decomposition of manganese sulphate, carbonate or hydrated oxides.

One of the key advantages that such a process would have over alternate processing schemes is the simplicity of reducing or eliminating dust problems and health hazards. A moving-bed process could avoid the dusting problem in the first place rather than relying on the design of complex and costly dust removal equipment.

Where to Use It

Metal Nitrates. In leaching operations in the nonferrous metallurgy field, sulphuric acid is generally a much more economical digestion medium than nitric acid. A major factor in the cost of nitric acid is the absorption of oxides of nitrogen in water.

A suggested processing scheme involving nitrates rather than sulphates consists of an aqueous slurry feed intimately mixed with a gaseous stream of NO and NO_2 to form metal nitrates. The nitrates are then processed by ion exchange, solvent extraction or fractional crystallization to produce a desired purity.

Recovery of fixed-nitrogen values from the various streams can be accomplished by several methods.

Metal nitrate pellets are fed to a moving-bed unit countercurrent to hot gases where they are decomposed to metal oxides. Effluent gases containing NO and NO_2 are recycled to react with additional feed.

Sufficient data are available on each of these steps to indicate that this process is technically feasible for a large variety of materials. Economic feasibility would have to be determined by rigorous evaluations of alternate processes using sulphuric acid.

Zinc Recovery. Recent studies on the recovery of zinc from sulphide concentrates by chlorination provide another example of an operation that could take advantage of the excellent temperature control, countercurrent action and solids-handling characteristics that are inherent in moving-bed processes.

These bench-scale studies used air-chlorine mixtures to chlorinate selectively and to volatilize zinc and lead chlorides, leaving behind unchlorinated iron or manganese. The zinc is subsequently separated from the lead.

Metal Sulphides. Modern moving-bed techniques are well suited to the volatilization of metal sulphides for the recovery of valuable metals, for elimination of undesired elements and for the separation of various sulphides.

In heating metal sulphides in the absence of air, there is a tendency for both decomposition and volatilization, with the characteristics of various sulphides differing very widely. Thus, by using a nonoxidizing atmosphere it is possible:

- To volatilize metal sulphides from nonvolatiles and separate them from each other (Hg, As, Si, Sn, Pb, Cd and Zn).
- To decompose sulphides with partial or complete removal of sulphur as in the case of Ag, Cu, Ni, Co and Mn. (Many sulphides such as those of Th, Hf, Zn, Ba and rare earths are very stable even at elevated temperatures.)

Manganese. Intensive studies have been conducted in recent years to develop an efficient process for beneficiating the large deposits of low-grade manganese ores in the United States. One of the most promising routes involves feeding ore and pellets of fines to a moving-bed or shaft furnace. This process is typical of many that can be developed in the metallurgical field.

The top section of the reactor is a relatively low temperature calcination zone where CO_2 is removed from the pellets leaving a more porous struc-

ture. This facilitates permeation of the solids by the sulphatizing gases (mixture of air and SO_2 from roasting of pyrite and pyrrhotite concentrates). The calcination zone is heated by direct contact of the pellets with products of combustion of gas, oil or other fuel. Bottom section of the unit is a cooling zone that leads to a continuous discharge mechanism.

The product is leached to remove $MnSO_4$, evaporated and the salt calcined to form manganese oxide. Another promising possibility would be the final evaporation and calcination of pellets in a moving-bed unit that handles directly nodules or pellets of manganese oxide.

Titanium. Many studies have been conducted and processes patented for continuous production of the intermediate $TiCl_4$ from ores such as ilmenite using moving-bed shaft reactors.

Briquettes containing mixtures of ore and carbon can be fed continuously by rotary valves into the top of a shaft furnace where they are preheated. As they move slowly downward, countercurrent to chlorine gas, the iron content is chlorinated preferentially. $FeCl_3$ passes out with the effluent gas while most of the TiO_2 is present in the solid removed at the bottom.

Variations of this method involve adjusting conditions to provide complete chlorination of both the iron and titanium, with removal, condensation and subsequent separation of the iron and titanium chlorides.

Binders such as molasses, tar, asphalt, sodium silicate and hydrated TiO_2 have been suggested for briquetting. Subsequent baking volatilizes hydrocarbons and water.

Interest has also been shown in the possible use of moving-bed techniques for continuous reduction to titanium metal.

Other Metals. Reduction roasting of iron oxide ores or concentrates in contact with a reducing gas can be conducted in a moving-bed apparatus in which pellets of iron oxide are reduced to sponge iron at temperatures controlled well below the melting point of the iron.

The sponge contains metallic iron plus silica and gangue minerals.

Reduction of many other metal oxides, such as CuO, NiO and WO_3, can also be conducted in similar fashion, with the temperatures controlled sufficiently below the melting point of the metal or other primary constituents. This allows the easy removal of the product as discrete pellets or briquettes.

Aluminum fluoride is commercially produced from aluminum oxide by hydrofluorination in a moving-bed type unit.

Moving-bed principles should find many new and broad applications in nonferrous metallurgical fields, in the preparation of intermediates as well as in subsequent reduction to metal. Possibilities of such continuous reduction methods are even further enhanced when these processes are carefully integrated with new developments for converting dispersed metal powder to massive form by: vacuum, inert atmosphere and other melting or sintering techniques; and by powder metallurgy.

SO_2 from Sulphides. In general, the primary reason for roasting pyrite ores is to obtain SO_2 for the production of sulphuric acid. The general mechanisms are similar whether pyrite is being calcined for metal recovery or roasted for SO_2 and sulphuric acid production.

For SO_2 recovery the amount of sulphur in the feed and the requirements for SO_2 concentration in the gaseous effluent are much higher than for metal recovery.

In zinc roasting the objectives are to produce a calcine for either electrolytic or retort zinc. Recovery of SO_2 is usually an auxiliary operation. Copper concentrate roasting is directed either at partial reduction of the sulphur content to correspond to the desired sulphur analysis in a smelter or at sulphatizing the copper to render most of it soluble in water or weak acid.

Fluidized bed and other techniques have been proposed for the roasting of arseno-pyrite gold ores to render them more amenable to cyanidation. To free the gold it is necessary to oxidize and volatilize the arsenic and sulphur. Factors of major concern are the minimizing of subsequent cyanide consumption while maintaining high gold recovery. The reactions involved are similar to others that have been successfully conducted using moving-bed methods.

Atomic Energy. The moving-bed technique is ideally suited for the conversion of UO_3 to UO_2 and UF_4. Other applications also appear to have promise. Due to security restrictions it is not possible to discuss these operations in any detail.

Solids-Liquid Applications

Although the emphasis in this report—and by far the greatest potential—is the contacting of solids and gases, it is interesting to note recent developments in the applications of the moving-bed principle to solids-liquid operations including: ion exchange and adsorption.

Unlike solids-gas contactors, where there is a very large density difference between the two phases, in solids-liquid systems the density difference is small. Solid flow rates that would be obtained by gravity flow are relatively low.

Until recently, ion exchange resins for water softening, demineralization and separation of ions were used in single-step batch or by fixed-bed operations. In the first, a batch of resin is equilibrated with a definite volume of solution. The fixed-bed scheme involves flow of solution to be treated through a stationary porous column of ion exchange resin. Periodic elution regenerates the column.

Drawbacks of such cyclic operations and the advantages of continuous, countercurrent, steady-state methods for the separation of ions were the bases for investigations of new ion exchange processes over the past five years by the Atomic Energy Commission and other organizations in the field.

Favorable progress has been reported on the development of several types of moving-bed processes with countercurrent flow of resin and liquid. Among the major obstacles to the development of these processes are the limitations of liquid throughput, solution densities and operational flexibility.

Several variations of the moving-bed principle for ion exchange applications have been reported recently.

One type involves downward flow of solution through a packed bed of resin, with periodic interruption of solution flow to remove the resin bed upward hydraulically in slug flow.

A second type utilizes a so-called spinner column or rotating cylinder to minimize channeling.

Finally, there are studies being conducted at several sites on truly continuous, countercurrent movement of both solution and resin bed.

Steady state, continuous operation is to insure a minimum of back mixing and ease of scale-up for commercial design from relatively small scale units. In most of these cases the resin moves downward continuously, countercurrent to the solution.

There is considerable interest at present in several modifications of these continuous countercurrent moving-bed methods for many important commercial applications. The technique has some really intriguing possibilities for the separation of constituents by variations of the techniques of fractionation and reflux that have been so widely used in distillation and even solvent extraction.

Among the most important applica-

tions of the moving-bed principle to adsorption using solids-liquid contacting is the Thermofor continuous percolation process. Thermofor continuous percolation was originally developed for decolorizing lubricating oils and waxes.

The process involves oil decolorizing and clay washing with continuous countercurrent flow of the liquid and granular solids. This has been integrated in commercial units with operations for drying and regenerating clay in industrial Thermofor clay burning furnaces.

Many industrial chemical operations are presently conducted by fixed-bed or batch adsorption techniques.

Many of these operations could be advantageously conducted by moving-bed techniques with continuous regeneration of the solids. The size of such equipment can be designed and instrumented for a broad range of capacities.

There have been many other suggestions and studies on the use of moving-bed methods for solids-liquid contacting operations in extraction, leaching and catalysis. However, there are no available experimental or cost data to show the relative economic merits of such applications, particularly in comparison with new or improved extraction and leaching techniques.

There has also been considerable interest in using moving beds of limestone for treating acid wastes.

II—Design Principles

The engineering problems pertaining to moving-bed processes should be considered as integrated design problems with due concern for all related or auxiliary components. Over-all design can be drastically altered by major changes in any of the component operations such as pelletizing, solids recirculation and heat transfer.

Among the factors of major importance in process and mechanical design of moving-bed processes are:

1. Solid feed preparation and solid characteristics.
2. Solids handling feeders, conveyors and level measurements.
3. Reactor designs.
4. Miscellaneous factors such as temperature, pressure, instrumentation and design philosophy.

1. Solid Feed Preparation

Whether you call it size enlargement, agglomeration or particle consolidation, production of a solid feed consisting of suitable discrete pellets, briquettes or compacts is one of the most vital and perhaps the key factor in adapting the moving-bed principle to any new process.

Whether or not size enlargement or feed preparation is designated as a new unit operation, it is certainly an art rather than a science because of the complexity of the physical and chemical factors involved.

Research and development studies on the processing of a vast variety of materials into pelleted or compact form have been guided to a limited extent by fundamental considerations. But mostly they have been guided by practical experience and empirical know-how. Even so, there is still no reliable substitute for actual laboratory work and, preferably, full-scale testing of the materials considered.

Sintering. The importance of metallurgical sintering operations in the preparation of pelletized feed for moving-bed type operations is illustrated by the development of low-grade domestic taconite ores. It is possible that many of the sintering operations might be better conducted by a moving-bed mehod. The possibilities here would be even further enhanced if the products of such an operation were designed for use in a subsequent moving-bed process.

The terms sintering, nodulizing, pelletizing, agglomeration, etc., when applied to operations involving partial or incipient fusion of the solid material or the added agent, all pertain to the same general process.

Rotary and moving-bed sintering machines involve continuous movement between the solid and the equipment. In the stationary hearths discussed below, there is no relative motion of the two. Blast furnace flue dust, manganese dioxide and other ore concentrates, magnesite and dolomite all involve sintering operations.

The rotary method involves kilns or dryers which are used for cement manufacture, blast furnace dust, ores, phosphate fines, flotation concentrates and dolomite. Sizes of these units range from 1 ft diameter by 18 ft long to 18 ft diameter by 500 ft long. Temperatures may go up to 3,800 deg F. Larger units can process over 5,000 tons of solids per day.

Use of rotaries has been somewhat limited because there is a tendency for fused rings and scale to form. Rotary units are more economical when operated continuously.

The moving-tray unit has been built for capacities of over 1,500 tpd. It is in essence a variation of the static method described above and has been used in the sintering and roasting of ores as well as in the cement industry. It is particularly well adapted to intermittent operations.

The static methods involve production of either random-sized sinters or briquettes formed with binders using pressure techniques. Typical applications are refractories, building bricks and tile, various ceramics and iron ore. They are somewhat more expensive than rotary methods.

Tumbling. Size enlargement by tumbling includes the production of pellets, balls or agglomerates without the application of pressure, although binders and heat may be used. The categories of tumbling, pelleting, granulation and balling differ primarily in the use of binders, the manner of heat addition and the size and uniformity of product.

Granulation occurs in rotary drying processes when attractive forces (cohesion, surface tension, etc.) acting between particles are sufficient to withstand rolling treatment. Coarsely crystalline materials will not granulate.

For a uniform product, the average diameter of the final granules should be several times the size of the largest particle in the mixture.

Pressure Forming. Pressure forming operations are very important for moving-bed use because of the uniform size, shape and properties of the products. The industrial applications are numerous. They range from briquettes of iron ore and coal to pharmaceutical pills.

Many operations such as conveyor drying, for which pressing or preforming methods are usually used as feed preparation, should be particularly suited to moving-bed applications—at least from the aspect of technical feasibility.

Preforming can be carried out by pressing material into grooved surfaces of internally heated drums where it is partially dried and discharged in the form of little sticks. An alternate method is to score the material on the drum of the filter and allow it to break at the discharge point into uniform lengths.

Extrusion. Extrusion provides a method for forming discrete particles or shapes from a mass of material which has been plasticized with a liquid in a mixing operation. It involves forcing a relatively plastic mass through appropriate openings at a pressure consistent with the flow properties of the mass.

When strength and dimensions of the product are secondary, screens and

perforated plates are used for pressing the plasticized mass. Dies are used for molding of the agglomerates on a large scale where relatively simple shapes and stiff masses are involved. Examples of the former are phosphate fertilizers and carbon black. Illustrations of the latter are catalyst pellets, clay and carbon electrodes.

The size and shape of orifices for both types are not predictable and must be determined experimentally. They are chiefly a function of the physical and chemical properties of materials at the conditions of extrusion.

Spray. Many unique and ingenious techniques have been proposed or studied for the formation of synthetic cracking catalysts. The spray method has attained considerable importance in the petroleum industry.

Spray methods involve the use of liquids or gases as the fluids through which material is dropped to achieve the desired shape, uniformity and other characteristics.

Selecting a Method. It is improbable that you will find only one pelletizing method for any given material.

For systems with high rates of recirculation of solid pellets—as in catalytic cracking — there are relatively rigid specifications for abrasion, attrition, thermal and mechanical shock resistance and other physical properties. For pellets used in either a once-through or relatively limited cyclic operation, these specifications are much less stringent.

It is desirable to minimize breakdown of the particles not only to prevent possible carry-over into the gaseous effluent but also to insure operation at a minimum pressure drop to avoid clogging auxiliary equipment. You should consider the range of temperatures, rate of solid recirculation and actual conditions to which the solids will be subjected.

Although preliminary tests can narrow the variables, evaluations must eventually be conducted on continuous, steady-state equipment to confirm the suitability of the pellets. Consideration also should be given to subsequent processing of the pellets after they leave the reactor, with a view toward simplifications and economies in further processing, recirculation or storage.

Various means for controlling hardness of pellets or briquettes have been developed. Important factors include: selection of conditions of formation of components and their admixture; control of moisture content in extrusion, casting and other methods; and proper choice of drying and other conditions.

2. Materials Handling

Among the factors of major importance in the engineering design of a moving-bed process are those involving: solids flow control, solids conveying and solids level measurements.

Solids Flow Control. Most of the solids feeders discussed here have been used for various applications in the petroleum and metallurgical industries. Many companies have evolved and patented novel innovations of principles involved in these units for a wide range of conditions of temperature, corrosion, solids flow characteristics, erosion, pressure and special hazards.

The problem of selecting a solids feeder is usually resolved by somewhat arbitrary decisions based on individual experience with a few specific types. Seldom is only one type suitable from the point of view of either technical feasibility or cost.

A systematic approach to the problem involves close integration of the feeder mechanism with:

- Preparation of the compact pellets or briquettes used as feed to the moving-bed unit.
- Conveying equipment.
- Anticipated temperature, pressure, corrosion, gas leakage and other conditions in the region of the feeder.

The selection and design of these feeders is still very much an art and a great deal of experimentation and vendor service work are usually desirable for new applications. Organizations that have broad experience and special know-how in pelleting, briquetting and preforming a tremendous variety of solid materials into discrete shapes, have also of necessity developed competence in the selection and design of solids feeders and conveyors. Among the problems encountered in feeder design are bridging, flooding, material sticking to the sides of the container, feeding against pressure and vacuum, gas seal, temperature, corrosion and erosion.

Related problems are the design of bins, hoppers and their discharge devices.

Much of what we have said about solids feeders also applies to bin discharge. The handling and storage of pellets and similar discrete material is generally much simpler than for powder or sticky material.

Solids Conveying. The technique used for solids conveying operations outside of the reactor proper is always a major factor in the over-all design of a moving-bed installation. It is a particularly critical consideration for operations that involve tremendous recirculation rates as in the catalytic cracking of petroleum hydrocarbons.

The two methods most widely used for moving-bed applications in the petroleum industry are pneumatic lifts, such as Houdriflow, and bucket elevators. Both operate primarily as elevators for recirculation of solids to the top of reactors.

Although there are many theoretical considerations, over-all designs of solids-conveying equipment are still basically empirical in nature for specific conditions and properties of materials involved.

Many types of conveyors have been proposed and studied in the petroleum, chemical and metallurgical fields. Without a doubt many of them should be reconsidered for new moving-bed applications. This is particularly true because most moving-bed applications will involve relatively little recirculation compared to petroleum practice.

Furthermore, physical and chemical properties of the solids involved in new applications are often inherently different from those previously encountered in moving-bed operations.

Among the other types of elevator conveyors that should be considered are: flight, skip hoists, vibrating units, pivoted bucket carriers, belts, continuous flow equipment, apron and belt, screw or ribbon, batch elevators and dense-phase upward flow.

For a once-through operation, the relative importance of the conveying system—as a fraction of the over-all investment—is far less than in the case of catalytic cracking of petroleum. It is common practice with catalytic cracking units to circulate many hundreds of tons of solid catalyst pellets per hour.

The selection of a conveying system for new applications should be based not only on cost considerations but also on thorough test data from vendors.

Although basically new conveying schemes might be designed, this procedure would really be justified except for operations such as petroleum cracking. One form or another of the wide variety of standard equipment available should be found suitable for practically any chemical or metallurgical operation.

Solids Level. Among the important instrument applications involved in most moving-bed operations are units for the measurement and control of solids level. Because of its importance to engineering design, much progress has been made in this field by instrument manufacturers as well as by the petroleum industry.

The engineer now has available to him a broad selection of automatic de-

vices to incorporate into moving-bed designs. The choice should be based on such factors as: the particular application (storage bin, hopper or reactor); high- or low-level indicating or control; requirement for indicating, alarm, recording and control; investment costs; precision required; instrument maintenance; temperature, pressure and corrosion characteristics of the system; and special hazards.

Gamma Ray—Solids level detection is based on a radioactive source mounted inside a vessel, with a radiation counter on the outside. As the solids level rises in the vessel, the solids absorb gamma rays and decrease the output detected by the radiation counter. Absorption of gamma rays depends on the density of the solids and the length of path through the solids.

They are particularly advantageous in that no openings in the reactor or container are needed.

Flexible Diaphragm — Mounted in the wall of a vessel and moves if contacted by solids, thus actuating a switch. When the level falls, a spring or air pressure returns the diaphragm and switch to their former positions. It can be located at intervals to operate alarms, indicators or controls.

Rotating Paddles—A paddle is rotated by a motor which is mounted so that as the paddle contacts solids, the torque produced is registered and converted to an indication of level. Can serve to indicate top level or to function as an alarm or feeder control.

Pendant Cone—An inverted cone is suspended from a rod in a housed switch. Any movement of the cone from the vertical position when contacted by solids is detected by the switch. They can function as alarms, indicators or controls.

Balanced Paddle—Paddle or horizontal arm extending into vessel through a diaphragm seal is balanced by a pneumatic transmitter. Solids contacting the paddle unbalance the arm and this indication is transmitted to a control unit. Characterized by rapid response.

Slack Detector—A small weight on a cable is lowered periodically into a vessel. When the weight strikes the solids level, the slack on the cable is indicated and a cycle-controlled winch reverses the cable. Cycle repeats so that the level corrects for each cycle.

Weighing Vessel—Total weight of vessel and solid contents are reported. Knowing the vessel weight and diameter, a very accurate determination of solids level is possible. Limited in use because of prohibitive cost, the use of strain-gage weighing may prove economical for certain applications.

Mechanical Probe—A vertical rod is mounted in a switch. Deflection of the rod actuates an electric switch and indicates level. Can be used for alarms, indicators or controls.

Grid Response—A grid consisting of thin metal rings is connected by rods to form a vertical cylinder. Insertion of the grid into moving-bed of solids (application restricted to continuously moving bed of solids) measures the internal forces related to density of material and solids level. Grid element connects to a torque tube and a pneumatic transmitter.

Miscellaneous Electrical Units — Characteristics such as electrical conductivity and dielectric constant of the solids are used to measure solids level. A probe is inserted in the vessel and solids contact with the probe either completes an electrical circuit or affects capacitance of the circuit.

3. Reactors

There are many factors involved in the design of solids-gas contacting reactors. Their relative importance varies with type of reactor and conditions of operation.

With so many important and potential rate-controlling factors to consider, most designs are developed from practical considerations in a more or less empirical manner. Usually there is a progressive scale-up of equipment from bench-scale through pilot plant and often through semi-works.

Tradition plays an important—and often a dominant—part in the development of new or improved techniques. This is illustrated by the classical shapes and dimensions of many of the furnaces and roasters used in the metallurgical industry, including equipment such as blast furnaces, rotary kilns and rabble hearths.

A number of design factors are established by process specifications for: product purity; scale of operation; continuous or batch processing; type of reaction; temperature and pressure; possible radiation, health or other hazards; and the general philosophy of design.

Other factors to consider in the design of a reactor are:

1. Flow of solids and gas.
2. Shape and dimensions of reactor.
3. Method of introducing and removing solids.
4. Method for maintaining uniformity of solids and gas flows in reactor.
5. Measurement and control for solids handling including conveying, feeding and quality control.
6. Distribution and disengagement of gases.
7. Separation and recovery of solids from gases.
8. Use of seal legs and similar techniques for isolating reactor gases.
9. Purging or desorbing gases from solids removed from vessel.

Space does not permit detailed discussion of any of the commercial reactors used in the metallurgical, chemical or petroleum industries. The following is limited to some general comments to indicate the large variety of basic designs possible.

Lime. A modern gas- or oil-fired moving-bed lime kiln has five zones: cooling, finishing, calcining, preheating and storage.

The trend in design of these shaft kilns has been towards larger capacities, center-burner kilns, either oil- or gas-fired furnaces. Practically all are continuous.

There have been many engineering modifications of these kilns, particularly in conjunction with different fuels such as oil, blast furnace and producer gases. In some cases, solid fuel is added with the charge; lime is then removed with ashes.

The interior design of the modern shaft lime kiln provides for suitable fuel and air distribution to insure adequate calcining and cooling. The chief advantages of these kilns over rotaries are greater operational flexibility, higher thermal efficiencies, lower fuel costs and smaller capital investment.

Cement. There is renewed interest in the use of moving-bed kilns for the production of portland cement in the United States. Improved designs have been suggested using conical-shaped shells to allow for contraction of the charge during burning. Additional improvements include more efficient feed preparation by pelletizing raw material on whirling drums.

Blast Furnaces. A moderate sized blast furnace might be about 20 ft in diameter 90 to 100 ft high, handling a feed of 1,200 tons of iron ore, 600 tons of coke and 250 tons of limestone to produce 600 tpd pig iron.

Purity, size and strength specifications for coke are rigid. Coke not only serves as reducing agent and fuel but also supports the entire charge as a permeable mass.

The furnaces are refractory-lined steel shells. The refractory material (a fireclay brick) must be designed to resist mechanical abrasion, fluxing at

high temperatures and the effects of strongly reducing atmospheres.

A hard, dense, superduty fireclay brick is used in the hearth and bosh sections. A water spray cools the inwall or middle section from the outside of the steel shell. Since the highest temperatures are attained in the upper section of the crucible and the lower part of the bosh, hollow metal cooler plates are set in the brickwork in these sections.

Blast furnaces of similar design are used for the manufacture of phosphoric acid and phosphorus by reaction of phosphate rock, coke and sand. The blast furnaces used for copper and lead, typical of those used for other nonferrous metals, are basically different in many respects from the iron blast furnaces.

Side and end walls of lead blast furnaces consist of steel plates through which cooling water circulates. The inside of the crucible is lined with refractory and the outside supported by steel bracing. Height and width of these furnaces are about equal; length is variable. Over-all size is much smaller than the iron furnace.

Multiple hearth roasters have replaced many of the small blast furnaces used for smelting copper and lead ores.

Miscellaneous Roasters. Multiple hearths and moving trays are among the more commonly used methods for the metallurgical roasting operations discussed in this report. Improvements and economies for many such operations are possible by replacing them with new or improved techniques.

Among the chief disadvantages of the fluidized-bed and flash methods which limit their application to metallurgical operations are: short retention time, the difficulty of even approaching countercurrent conditions and the tremendous amounts of solids entrained in the gas streams. These factors are precisely the characteristics that distinguish the moving-bed method.

A recent development is the so-called "atomized suspension process," in which solutions or slurries to be treated are atomized into the top of a tower, the walls of which are maintained at an elevated temperature. Radiant heat transfer is utilized in this process which appears to be a variation of the spray-drying technique.

Flash roasters were developed from observations that most of the reactions in multiple hearth furnaces occurred as solids dropped from hearth to hearth. The flash roaster has many features in common with fluidized-solids furnaces.

Continuous vertical shaft kilns with baffles or trays, rotating plows and a central vertical shaft, have been built in sizes of over 35 ft in diameter and 60 ft high. There are many variations in size and design of such units. They are also known as rotary shelf dryers with a number of characteristics that are basically similar to moving-bed units such as: extreme operating flexibility and variable retention time.

The general flow of gases in these rotary shaft kilns may be concurrent or countercurrent to the solids. Capacity depends partly on the rate of rotation of the plows or shelf but primarily on the characteristics of the materials to be dried.

One of the most widely used multiple hearth furnaces is the Nichols-Herreshoff which contains a number of circular horizontal hearths, a steel shell supporting the hearths and a central rotating shaft carrying the rabble arms.

The Wedge roasting furnace is characterized by a central air-cooled shaft of sheet steel. The diameter is designed to permit replacement of rabble arms and blades through the shaft. Rabble arms are water cooled and provided with cast-steel breech blocks. This permits quick removal and replacement of the arms without hampering furnace operation.

There are many other vertical roasters of the multiple hearth type and others with ingenious designs for moving solids continuously through baffled shaft kilns. Many of them have been developed from operating improvisations. However, we believe that modern moving-bed techniques will prove more efficient and economical for many applications.

4. Miscellaneous Design Factors

In addition to the fundamental concepts discussed earlier, important features in the design of moving-bed processes are temperature, pressure, corrosion, erosion, solids properties, instrumentation and general design philosophy.

Most of these are related independent variables. For instance, we cannot discuss temperature without heat transfer, kinetics and fluid mechanics. Similarly, solid characteristics are related to such factors as kinetics and feed preparation.

It would not be realistic to generalize on any one of the huge variety of variables encompassed in moving-bed operations. Each application must be considered on its own merits, taking advantage of all available tools, techniques and engineering know-how.

Temperature. In many cases, reaction rates increase in direct proportion with temperature; and maximum rates correspond to highest attainable temperatures.

Maximum rates are limited by: physical and chemical characteristics of solids and reactant gases; possible undesirable side reactions; transfer of large amounts of heat over short periods of time; fabrication of suitable refractories, engaging and disengaging devices for gases and solids; design of elevators for recirculating hot solids; proper provision for thermal expansion and contraction of equipment.

There are many instances where increased temperatures result in diminished reaction rates. The decrease of equilibrium constant with increase in temperature may more than offset the increase of the reaction velocity constant. Thus, we may get an over-all reduction in reaction rate.

Indeed, the reaction may be reversed if the temperature is sufficiently high.

In moving-bed operations, temperature is particularly significant since precise temperature profiles or gradients can provide optimum results.

Pressure. Absolute pressure, pressure differences, gas leakages and pressure drops are all important factors in the design of moving-bed equipment.

High pressures increase fabrication costs. Maintenance of pressure differences between vessels requires either mechanical devices or seal legs. The mechanical methods include continuous or intermittent valves and pressure chambers. Seal legs function by pressure drop of fluid which flows through an appropriate length of leg at a rate that produces the desired pressure differential.

Materials of Construction. The material to be used for construction is a vital subject that often determines the over-all feasibility of a proposed process.

Reliable information is usually attainable only from actual performance data, preferably on a large scale simulating proposed plant operations. This applies to erosion, corrosion, chemical resistance, thermal and mechanical properties of metals, ceramics and other materials.

The many process variables that we have discussed up to now have an important bearing on the selection of suitable materials. Final choice will naturally be based on the most economical of usable materials.

New developments in metals and ceramics are constantly extending the range of operations to higher temperatures, pressures and severe corrosive environments.

Instrumentation. Process variables are conditions or states of a material

or its environment which are subject to change. Each process must be analyzed separately to ascertain what these process variables are and the minimum number that require separate control.

Many of them are dependent variables which are indirectly controlled by others. Final decisions on the choice of controllers, indicators and recorders are usually based on considerations of suitability, accuracy, reliability and cost.

Space does not permit more than a very cursory discussion of this vital subject. Suffice it to say that instrumentation has come to be regarded not as a separate or auxiliary operation, but as an integral part of modern continuous processes.

Naturally, the degree of refinement of automatic measurements and controls becomes a matter of engineering economics and must be justified in terms of improved product quality and minimized operating problems.

Design Philosophy. Actually, the predominant variable in determining the cost of a moving-bed or other type of installation is the over-all engineering design philosophy. This varies considerably depending on the industry, locale, amortization schedule, etc.

In some installations, spares of pumps and tanks are held to a minimum. Gravity flow is used extensively. Units are not enclosed. Inexpensive materials of construction are specified. Capital investment is held to a low value in spite of higher maintenance and other operating costs. Conversely, other designs for basically similar operations may specify stainless steel wherever possible. They may specify excessive spares on turbines and motors, well-paved roads and many extra provisions.

Thus in translating the general moving-bed or shaft principle from one industry to another, it is important to develop technical and cost data for each specific case. This makes it mandatory to proceed with care in the interchange among various industries of such items as: design procedure, estimates of investment and operating costs, labor and maintenance requirements, instrumentation and batch operations vs continuous operations.

Design Hints For Successful Moving-Bed Operations

1. Where an undiluted product gas is desired, the possibility of using an inert diluent gas is eliminated. However, there still remains the possibility of recycling product gas for the desired heat effects, assuming its characteristics will permit.

2. For very fine solids, where the minimum of gas flow is actually required, if the heat input or withdrawal can be suitably provided, the limiting factors are flow characteristics of powder and tendency to pack or bridge as in storage hoppers.

3. Heat may also be added by inert solid diluents if this is permissible and provided the solid can be retained or suitably removed from the product. This would take advantage of heat capacity of solids to minimize or possibly eliminate heat for internal heat exchangers.

4. Distribution of solids flow across the reactor is intimately related to the method of withdrawal of the solids from the cross-section of the bed, whether the solids move in up- or down-flow.

5. Kinetic data obtained for pellets are not always directly relatable to information obtained for powder or other forms.

6. Flow characteristics should be evaluated at the temperature of operation. No single factor can be studied to the exclusion of others since they are all closely interrelated and frequently in an obscure way.

7. Component testing can eliminate much of the pilot plant work. The scale of operation is, of course, a very vital factor.

8. The need for a given maximum temperature difference should be carefully determined. If this temperature difference is actually larger than expected, it is often possible to obtain considerable economy by eliminating extra provision.

9. The relation of actual equipment to measure temperature values from bench-scale work should be carefully considered.

10. The variation of temperature is often difficult to determine since observed values are often based on statistical averages from thermocouple wells.

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In an industry loaded with energetic and talented people, our nomination goes to Dr. Raymond E. Vener as one of the more industrious and talented. He is a full time process consultant and process engineer with Catalytic Construction Co. in Philadelphia, he teaches graduate courses at Drexel Institute of Technology and somewhere, somehow manages to squeeze in time to turn out top-notch technical articles. *E&MJ* readers saw two of his works in the August 1956 issue; one a thought provoking analysis of metallurgical classification, the other a comprehensive round-up of solids-gas contacting processes for metallurgical engineers.

Dr. Vener received his Ph.D from the University of Pennsylvania in 1948 but he has been a busy consultant on atomic energy projects since 1942.

In 1951 he joined Catalytic and has been active in both sales and design work on that company's projects in the fields of atomic energy, metallurgy, chemical and petroleum engineering. Atomic energy work at Catalytic has included milling raw and feed materials, separation of isotopes, reprocessing of spent fuels, design of power reactors and other engineering problems.

This article on the Moving-Bed Processes includes the applications and design principles involved. Because of space limitations the section on fundamental concepts has been omitted but will be presented in a forthcoming issue and cover fluid mechanics, mass and heat transfer, kinetics and applied physical chemistry.

We are indebted to Dr. Vener for this article on Moving-Bed Processes. His competence and his outspokeness make him one of our valued contributors.

REGULAR LUBRICATION and cleaning of the ropes is best way to ward off corrosion, stop abrasion. The extra care pays off in more working life.

DROP OILER installed to dragline head sheave doubled rope life.

Careful Operation

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CHARLES LAYTON

WIRE ROPE is like any other precision tool—there is a right way to use it and a wrong way.

Given care and attention, wire rope will be a faithful servant that provides generously in long life, easier handling and installation, safer operation and economy. Today, when wire rope is called on to do a variety of unprecedented jobs, proper use is especially important. A well-cared-for rope can increase production by doing these jobs faster and more efficiently—and by lasting longer.

Get the Right Rope

A wire rope is made up of several strands (many wires braided around a center) laid helically around a core, which may be fiber, another strand, or an independent wire rope. The rope is a machine, for the instant a line is loaded or operated, each one of the wires is put in motion.

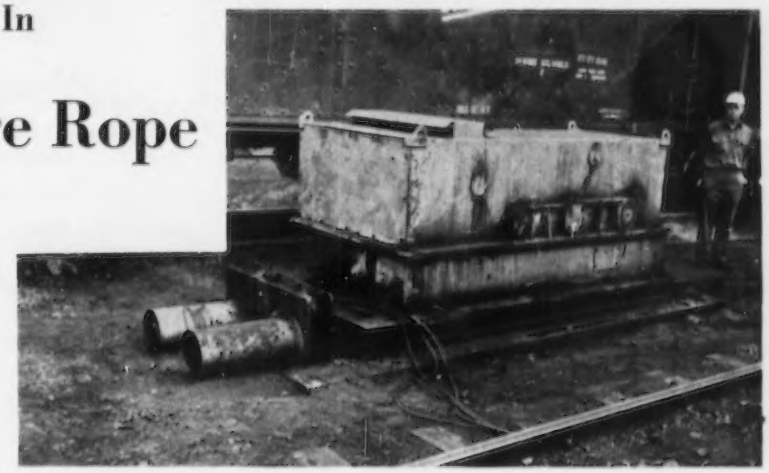
Mr. Layton is the chief engineer of the Wire Rope Division of American Chain and Cable Co., Inc.

CHAIN to go around loads with sharp edges keeps them from cutting rope.

SISTER SHEAVES ON DRAG BOOM keep the hoist rope from slapping under fluctuating lead, also prevents breakage of boom's tubular section.

Like This Will Result In

for Your Wire Rope



SELF-ALIGNING CAR HOIST with direct pull installed at track-side loading area to cut down rope wear. It is anchored to compression coil springs.

There is no such thing as an all-purpose rope, but there is a maze of different types and sizes on the market, each especially designed for a particular set of jobs. There are nine major points to be considered in choosing the wire to buy: length, diameter, number of strands, number of wires per strand, arrangement of the wires in the strands, kinds of fabrication, lay, strength classification and kind of core. All these components must be taken into consideration, and a consultation with an engineer from a wire rope manufacturer is often a good move to make before buying.

The purchase is just the beginning. When the rope arrives, there are many areas where care must be exercised if maximum usefulness is to be achieved.

And Treat It Right

Storage: The rope always should be stored under a shelter. The paper wrapping the manufacturer has placed around the reel is designed to keep out dirt and moisture in shipment, not as protection against prolonged periods of exposure to rain or snow. This wrapping, in fact, can serve as a pocket at the lower side of the reel to hold the wet, so it should be removed or at least punctured at the bottom before the rope is put into pre-use storage.

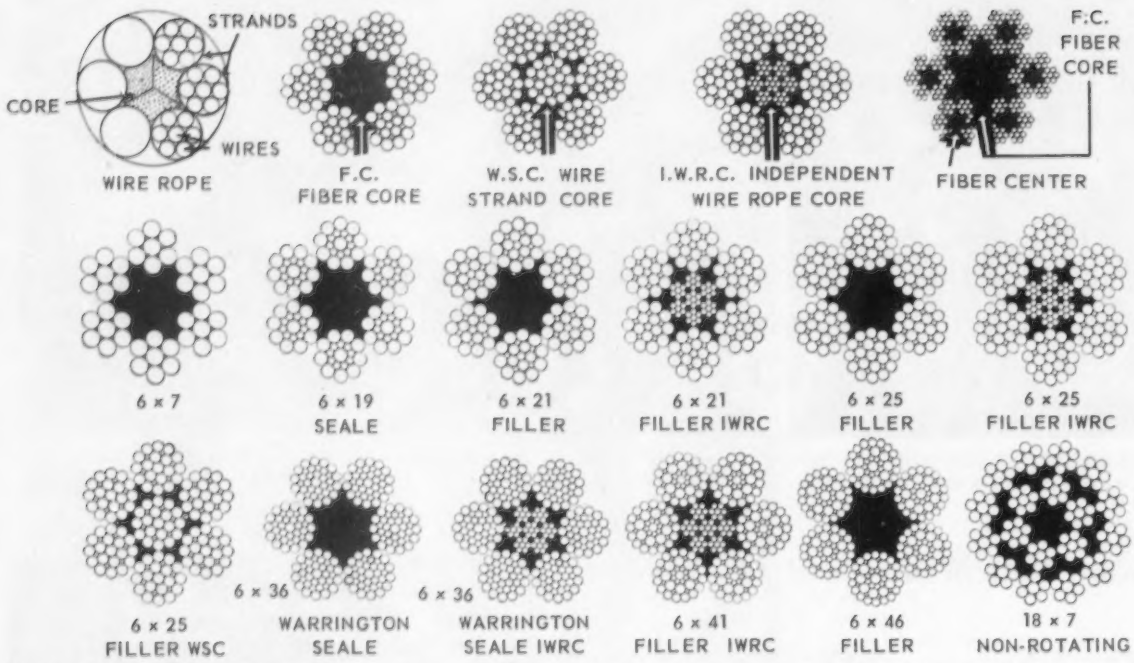
Put the reels in a simple shed or under a galvanized corrugated steel covering, stowed high on pins or racks, safely out of the way of equipment which might run over them were they left on the floor. And tag each reel for quick, positive identification, so a worker in a hurry won't pick up the wrong rope just because it's the same size or looks similar.

Installation: In installing the rope, careful attention must be paid to both the coil and the point where the rope is entering the reeving end of the machine. A kink at either end causes unequal tension and undue wear, and too often an operator has been watching one end so attentively that he's missed a dog-leg developing in the other. Never unreel the rope in loops; it causes an unnatural twist.

It's a good idea to mount the reel so that it, too, unwinds over the top when the rope is being wound over the top of a drum. Conversely, if the drum is wound from the bottom, the rope should be coming off the bottom of the spool. The reel should, of course, be jacked up on a horizontal axis.

Take it easy once the new rope is on the machine. Break the rope in just as you would any other delicate mechanism—at slow speeds, with light loads. Increase the strain gradually up to the full loads required by the work. A little time will be lost, but it will be more than repaid in extra days of rope life.

Typical Wire Rope Constructions



WIRE ROPE CONSTRUCTION is designated by two numbers, first giving number of strands and second showing number of wires per strand, and code for type of core: fiber, wire strand or independent wire rope.

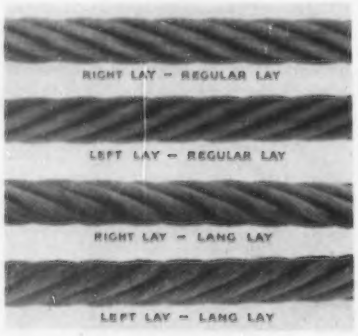
Operation: It is in the actual day-to-day operation of the wire rope that the largest amount of abuse is dealt it, and it is here that the faults are the easiest to correct. The watchword is, "Be Careful!" Most operators are well aware of the proper way to use their wire, but not infrequently one forgets to apply the techniques he knows or "sluffs off" at some phase of the job.

Shock loads overstress the rope and greatly shorten its life. Smooth acceleration will prevent these shocks, and attention to the fact that no slack rope or jerking movements may be allowed. And the loads must not exceed the rope's working limit.

Periodically a hoist rope should be detached from the skip and allowed to rotate freely to rid itself of crooks that are prone to concentrate there. For permanently attached cars, a swivel should be used to let the rope untwist. It is also good practice to cut, every few months, a short section from the part of the rope adjacent to the cage or skip connection, for it is this area of the rope that is most subject to vibration and subsequent fatigue.

Check the Rope

Frequent inspection is vital to get optimum use from your wire rope. Done with care, it can not only evaluate the present rope condition, but can show up the causes of any loss of strength so remedies may be applied. The inspector must be on the lookout for corrosion and breaks due to either abrasion or bending fatigue or to a combination force called abrasion fatigue. Fatigue breaks, as distinguished from those caused by abrasion alone, are sharp clean fractures of the wire—possibly slightly burred at the line of final separation. They are caused not only by bending around sheaves or drums, but also by track cables of aerial tramways and cable ways as the load traverses them. To stop these breaks, use sheaves and drums of the proper diameter, and do away with reverse bends. If the operation requires these bends, use sheaves as large as possible and spaced as far apart as possible.



IN LANG LAY ROPES the wires in the strand and the strands in the rope are laid the same way; in regular lay, they are laid the opposite way.

When checking for abrasion, of course, wear on unseen wires must be considered. By gaging the diameter of the rope at points of greatest wear, some indication of internal abrasion may be arrived at. Nicking and scarfing—special kinds of abrasion—are frequently caused by improper spooling, so this is one more point to watch for.

When wire breaks are found in lang lay ropes protruding ends should be broken off at the line of contact between strands. This quick job with a pair of pliers will keep the protruding wires from notching those adjacent when the rope passes onto a drum or sheave.

Lubrication's the Best Bet

The best way to prevent corrosion and to check abrasion is proper and frequent lubrication—whether the rope is working or not. Wire rope engineers look upon the lubricant as a neces-

sary part of the product they make, for the wires must move freely when load is applied and when the rope passes around sheaves and drums. That is why lubricant is applied at the mill so thoroughly that every fiber of a fiber core, each strand, and, in the majority of cases, the finished rope body is lubricated.

Frequency of lubrication depends on conditions of service—load, speed, bends, presence of abrasives, moisture, acid or other corrosives. The overriding control is that rope parts must not be permitted to lose their protective supply of lubricant.

The ropes must be lubricated internally as well as externally. Smearing grease on the outside of a wire rope is not lubricating it. If the lubricant does not penetrate to the inner wires, these inner wires will rub against one another, causing more needless wear.

The differences in wire rope construction complicate the selection of a proper lubricant for the inner wires —chiefly because the lubricant, once it reaches these wires, must have the ability to cling to them until it is worked out. Generally, wires of smaller diameter are better lubricated with lubricants of lighter viscosity, but plentiful penetration to the inner wires must always be the prime consideration.

Extra-Life Hints

There are many special practices that can add extra time to the rope's working life. Here are nine helpful hints to remember:

- Keep used rope that may still have some life in it coiled, or, if it's long, wound on a spool.
- Keep the coil out of dirt and sand when rolling it along the ground.
- Avoid overwinding whenever possible.
- Don't crisscross the rope on drums.
- Replace worn sheaves—be sure grooves are larger than the rope, smooth, unwobbling, and of a durable material.
- Keep the sheaves aligned—uneven groove wear is a hint that the sheaves are out of line.
- Use slope rollers with diameters at least nine times the diameter of the rope, or use grease-impregnated scrubbing boards instead.
- Watch for stuck rollers—they're troublesome.
- Use a rope long enough so it can still be used when the first 100 ft. —the section receiving the hardest wear—are cut off.

When to Retire Rope

No rule can be set up as to when a wire rope should be discarded as unsafe because of too many broken wires, but in making decisions records should be kept of both the total number of wires broken within the length of one rope lay and number of adjacent wires that are broken in any one strand. Elastic stretch may provide another clue to a rope's usefulness, for when a rope loses its ability to stretch and then snap back to normal length, it is becoming—or has become— unsafe. No easy formula can apply to the multitude of different wire rope applications, but manufacturer's laboratory analyses of typical sections can assist you in establishing safe and economical practices for your operation.

A mountain climber treats the rope to which he entrusts his life with great care. A good mechanic does the same with a piece of precision equipment. If you show similar care for wire rope—the tool that is both a rope and a machine—it will give you long a dependable service. •

Watch These Trends

James W. Franklin

MAGNESIUM will be used to build the earth satellite to be launched by the Navy, according to Howard Perkins, president, Brooks & Perkins, Inc. In a two-fold announcement, Mr. Perkins also stated that B&P will join Dominion Magnesium, Ltd., Toronto, in forming Alabama Metallurgical Corp., to form the first U. S. competition for Dow Chemical Co. in the magnesium field. A $7-million plant will be erected at Salem, Ala.

In another first for Alabama Metallurgical, it was announced that this 10,000-tpd plant will use the ferrosilicon route, rather than the Pidgeon electrolytic process used by Dow. Dominion Magnesium has been using this process, which reduces dolomite to magnesium with ferrosilicon. Price is comparable to the electrolytic route and the quality of the magnesium is said to be higher by the ferrosilicon process.

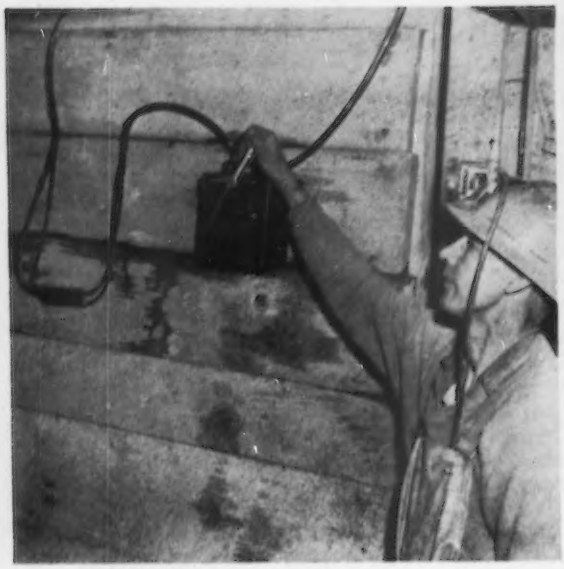
Among the reasons that Alabama Metallurgical was formed, the foremost was the increased and extensive use of zirconium and titanium in tomorrow's metallurgy. Both metals require magnesium for reduction; and the ferrosilicon method is said to yield better raw material for the Kroll process than does the Pidgeon electrolytic process.

Dow Chemical recently announced a new magnesium-thorium alloy that is available in production quantities and has high temperature applications.

ENAMELED STEEL wall curtains, only 2.5 in. thick have heat insulating equal to 10 to 12 in. of standard concrete block, according to Bettinger Corp. This, coupled with its lighter weight and lighter framing demands, lower installation cost and complete lack of maintenance makes four good reasons why the use of porcelain-enameled steel is on the rise. Latest development is that the 21-story Sheraton, Hotel, Philadelphia, will use enameled steel for all outside panels.

ZINC requirements for the die casting industry in 1957 will approach 420,000 tons, according to American Die Casting Institute figures. At the same time, the Institute predicted that their industry would need 372-million lb of aluminum to satisfy projected production schedules. Big end-use is still tied to automobile production (6.5-million passenger cars forecast for 1957).

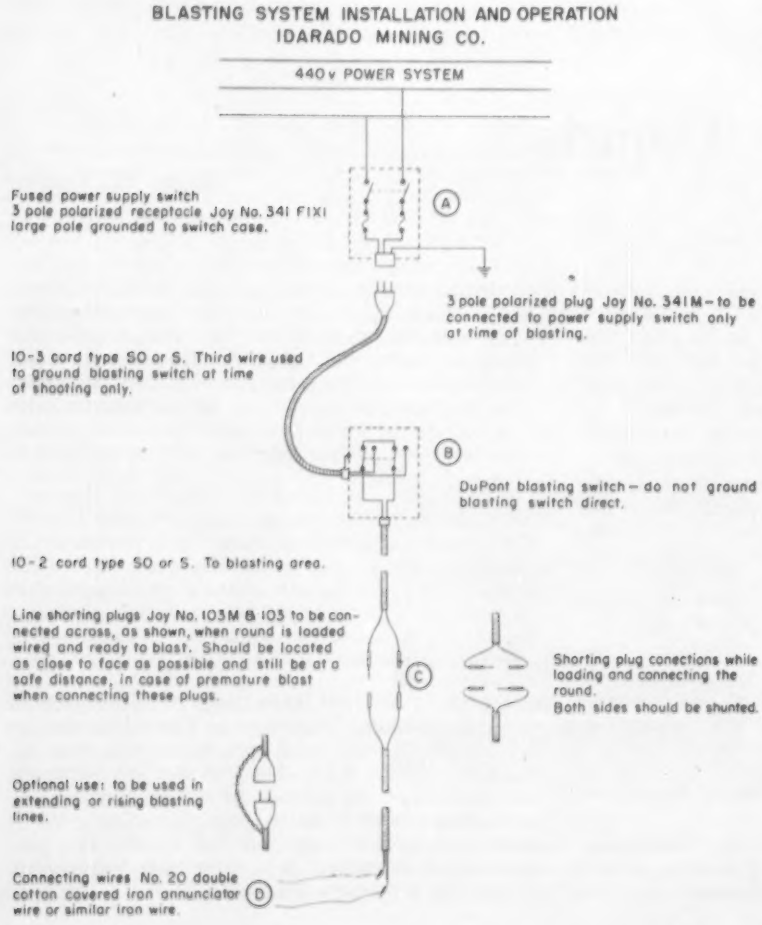
GERMANIUM AND SILICON transistor price reductions announced the first of September by General Electric Co. places them in actual price competition with other dry rectifiers of equal rating. This will certainly widen the sales distribution and increase the amount of silicon and germanium needed by the industry. According to W. O. Hoverman, sales manager, General Electric Co., consumption of germanium and silicon units will increase by 4,000% in the next nine years.



Introduction of ideas like these . . .

FUSED POWER SUPPLY SWITCH which can supply more than one blasting circuit is connected to 440v supply at site.

FAST DELAYS of 100 and 35 millisecond intervals were added to the original 15 periods of millisecond delays.


BLASTING SYSTEM INSTALLATION AND OPERATION
IDARADO MINING CO.
440v POWER SYSTEM
Fused power supply switch
3 pole polarized receptacle Joy No. 341 FIXI
large pole grounded to switch case.
A
3 pole polarized plug Joy No. 341M – to be connected to power supply switch only at time of blasting.
10-3 cord type SO or S. Third wire used to ground blasting switch at time of shooting only.
B
DuPont blasting switch – do not ground blasting switch direct.
10-2 cord type SO or S. To blasting area.
Line shorting plugs Joy No. 103M & 103 to be connected across, as shown, when round is loaded wired and ready to blast. Should be located as close to face as possible and still be at a safe distance, in case of premature blast when connecting these plugs.
C
Shorting plug conections while loading and connecting the round.
Both sides should be shunted.
Optional use: to be used in extending or rising blasting lines.
Connecting wires No. 20 double cotton covered iron annunciator wire or similar iron wire.
D

How Idarado

W. L. GRIFFITHS
C. C. CHAMBERLAIN

INTRODUCTION OF AN ELECTRIC BLASTING system by Idarado Mining Co. has resulted in a number of advantages including more efficient use of powder, fewer missed holes, safer mining and considerable savings in slushing, tramming and crushing costs through better fragmentation.

Electric blasting is currently used in all phases of primary rock breaking which include stopes, stope preparation, drifts, crosscuts and raises. Most of the rock breaking is done on the silicious veins from 4 to 18 ft wide, which have average dips of 65 deg definite, gougy hanging walls and footwalls.

Prior to 1948, all blasting was done with cap and fuse with relatively satisfactory results. Increased labor costs, generally higher material prices and a fluctuating metal market prompted blasting practices as one phase in an over-all efficiency program. Such a program would necessarily have to

Mr. Griffiths is mechanical superintendent with Idarado Mining Co. Mr. Chamberlain was formerly chief engineer.

. . . Paid off in spots like these

TIME SAVED in capping fuses amounted to one manshift per day. Over 600,000 caps have been fired without accident.

BETTER FRAGMENTATION through more effective use of powder has meant savings in slushing, tramming and crushing.

Improved Its Blasting Practice

result in increased tons per manshift, better fragmentation and safer mining conditions. It appeared to us that the control afforded by electric blasting would best aid in gaining these objectives.

Chief difficulty inherent in this concept was the fact that over the years the miners of the area had formed an adverse opinion of electric blasting and would actively oppose its introduction. To overcome this attitude, it was necessary to set up a safe and dependable electric blasting system. This was done with the aid of explosive technicians who had successfully faced similar problems elsewhere. The technicians and company supervisors instructed the mining crews in proper electric blasting techniques and safety benefits and emphasized the monetary advantages available to the crews through more production.

Safety Principles

Main principles of a safe and dependable electric blasting system are that it must be completely insulated and properly maintained, and that all other paths which extraneous electricity uses to return to ground must be tied together in a general mine ground system. In addition to insulation as protection, miners must have convenient shunting devices which also break the blasting line.

Power Source

Since 440v ac three-phase system power was required in all mining areas for slushers, pumps and various other power driven devices, providing power for electric blasting was no particular problem, and blasting power used in all mining areas is therefore 440v one phase.

All operations are provided with a typical electric blasting system shown at left, and described in detail as follows:

A fused power supply switch (Unit A) is connected into the 440v power system at the site where the blasting switch is required, and can be used to supply more than one blasting circuit if advisable.

Blasting switches (Unit B) are plugged into the power supply switch when the round is ready to be fired. All the blasting circuits into the mining areas are type SO or S cord with the necessary safety shorting plugs (Unit C) spliced into the line. Shorting plugs are placed as close to the area to be blasted as possible, and yet afford the man connecting in the shorting plugs protection from a premature blast. Another reason for placing the shorting plugs as close to the blasting area as is feasible, is to reduce the amount of cord into the immediate mining area and hence the exposure of the line to any other source of power. Size of cord to carry blasting power to the mining area is 600v 10-2 type SO or S.

Reducing Lead Wire

To reduce the amount of lead wire required from the end of the power lead cord to the caps, blasting cords are carried into the stoping areas as close as possible without incurring excessive flying rock damage. It has been Idarado's experience that the losses of blasting power cord have been very small, even when carrying blasting cords within 50 ft of a stope round if the cord is judiciously handled by the miners.

Connecting wires (Unit D) from the end of the cord to the primers are No. 20 double cotton covered, iron

annunciator wire. The general rule for connecting rounds is that not more than primers are to be connected in one series. If there are more than 30 holes to be blasted, more than one series is used. The number of primers in series, the size of power cord, and the size and type of annunciation wire were based on providing a safety factor of from 4 to 1 to a minimum of 2 to 1 in voltage and current requirements to fire a round.

Miners are cautioned to keep as close to the maximum number of primers in series as possible and also to balance their series rounds if more than one is used. The purpose of this is to keep the current in the power feed cord and the connecting wires to a minimum.

To facilitate the installation of blasting power systems in mining areas and to reduce the time of interference of maintenance personnel in a mining area, plug and receptacle cord sets (not to be confused with shorting plugs) have been used extensively. Miners successfully extend their own blasting lines using such cord sets thus eliminating the use of qualified electrical personnel for such minor operations.

Success Factors

Success of an electrical blasting system depends on the competent maintenance of such a system and all of its components. Components have been selected that require a minimum of maintenance and offer a maximum of service. Power cords when removed from a mining area are brought to the surface and vulcanized if necessary, tested and returned to service. The total loss of such cord used in the power supply system has been at a minimum with some cords being reused for a period of years.

Iron annunciator wire and iron leg wire caps were recently introduced exclusively in all blasting circuits to eliminate the harmful effects of tramp copper wire in the mill feed. Tramp copper produced undesirable effects in the mill amalgamation circuit and also reacted detrimentally with the cyanide used in the mill flotation circuit.

Safety Record

Over a period of four years when all mining operations were electrically blasted, there have been very few missed holes and there have been no electrical blasting accidents of any nature. During this period 1-million tons of rock were broken and 600,000 caps were blasted with the above electrical blasting system.

Maintenance and installation by the electrical department involved 1 man hour expended per 181 tons broken, or approximately 1c per ton. Primers are made up at the face by the mining crews, so that 1 manshift per day devoted to the capping of fuse has been eliminated. This cost reduction involves 1 man hour expended per 225 tons broken, or about ¾c per ton.

Miners Know the System

Probably the best indication that the mining crews are thoroughly familiar with the system and proper loading and hookup techniques is the fact that while galvanometers are available, missed holes and malpractice in connecting rounds are so rare that they are seldom used.

Development headings (all drifts, raises and crosscuts) and stope preparations used the standard blasting system with regular electric delay electric caps.

When using cap and fuse, the following difficulties were generally encountered: Occasional missed holes, the out of rotating firing due to insufficient trim, large blocky muck, and damage to the weak hangingwall with the consequent danger to crews from large loose slabs.

Concurrently with the installation of the electrical system in one stope at a time, millisecond fast delay caps were introduced, and the resulting muck piles examined to determine the effect on fragmentation. Several improvements in conditions were almost immediately noted: greatly improved fragmentation fewer bootlegs with vertical stoper holes, producing a safer and more uniform back, fewer slabs loosened on the hangingwall, and no unexploded powder in the muck pile.

Further Advantages

After sufficient instruction in electric blasting had been given to the crews, two additional advantages of electric blasting appeared over shooting multiple stope round blasts with cap and fuse. From a safety standpoint escape from smoke was eliminated permitting an orderly exit from the stopes, and additional men were not necessary for shooting the multiple rounds as is mandatory under state law.

Originally 15 periods of millisecond delays were used to shoot a maximum number of rows of holes to a vertical stope face. In 1955 five additional periods of fast delays at 100 millisecond intervals were made available. Some work in tight ground in narrow veins indicated that the 25 millisecond interval in the lower periods might be too fast for a clean break, and consequently the 5 higher periods were substituted for 4 alternate lower periods.

Period sequence is now Instantaneous, MS50, MS100, MS150, MS200, MS250, MS300, MS350, MS400, MS450, MS500, MS600, MS700, MS800, MS900, and MS1000, which provides at least a 50 millisecond interval. Judgment resulting from observation indicated cleaner breaking with no discernible difference in fragmentation. It is believed that it is not only the so-called compound action of millisecond blasting which contributes to fragmentation, but the fact that since no powder is found in muck piles, all of it must have detonated to work toward breaking rock. With cap and fuse blasting, it was common to find undetonated powder in the muckpile which was wasteful and dangerous.

Better Fragmentation

In addition to the aforementioned advantages in using electric blasting, recent work has indicated that a ⅛-in. increase in powder diameter could aid further improvement in fragmentation and tons per foot of hole. With cap and fuse blasting, a 1x16-in. cartridge was the maximum which could be easily loaded throughout the mine. The elimination of the space occupied by fuse made it possible to load 1⅛x16-in. cartridges, which in effect increased the observed loading density from 0.50 to 0.55 lb per foot of hole with 1-lb. diameter powder to 0.70 to 0.75 lb per foot of hole with 1⅛-in. diameter powder.

In conjunction with the move to a larger powder diameter, supervision was successful in having the mining crews put a greater burden on the holes. This resulted in no increase in cost per ton for explosives since the yield was more tons per foot of drill hole.

The authors appreciate the helpful suggestions and cooperation of John S. Wise, general manager, Idarado Mining Co., and the staff at the mine, who contributed generously to this article. Much credit should be given to B. S. Richards and E. M. Fowler, respectively sales representative and technical representative of E. I. du Pont de Nemours & Co., for the liberal time and help in developing the electric blasting program and technical assistance in compiling this paper.

For useful data on blasting, see "Explosives and Their Applications," *E&MJ*, Mid-June 1956.

It's built like a tire!

That's right! U.S. Royal Cord is built like a tire... *it has to be,* to take the battering it gets on all kinds of jobs, under extreme pressures. U.S. Royal Cord is hit by rocks in blasting; heavy tools fall on it; trucks and other vehicles roll over it; workmen pull it over jagged rocks. But U.S. Royal's unique cord construction, borrowed from "U.S." tiremakers, lets U.S. Royal come through unharmed. Needs no cribbing. Despite its great strength, this hose is very light and flexible.

- Tube of high quality neoprene for maximum oil resistance.
- Braided cotton breaker ply anchors tube to carcass everlastingly.
- *Exclusive:* Two counter-spiraled plies of tough special yarn floated in resilient rubber for outstanding strength, shear resistance and flexibility.
- Tough, brown, natural rubber cover (strongest ever put on a molded hose) gives excellent cut and abrasion resistance.

Buying second-rate, short-lived hose is no short-cut to economy. Get "U.S." quality hose for the biggest savings. No matter what your hose problem may be, "U.S." can solve it. Get in touch with any of United States Rubber Company's 27 District Sales Offices or write us at Rockefeller Center, New York 20, N. Y. You will obtain the correct job-engineered hose, and the guidance and advice of an expert staff of "U.S." engineers.

Mechanical Goods Division

United States Rubber

PERSONALS

RUSSELL W. BEAMER, former Pennsylvania coal and engineering official, has been named executive secretary of the newly organized Wyoming Mining Association with state headquarters in Riverton. Mr. Beamer is a graduate of Penn State University and at the time of his appointment with the Wyoming Mining Association, he was employed by Methods Engineering Council, a Pittsburgh, Pa., management consulting firm.

Ross D. Leisk has resigned as a vice president of Sunshine Mining Co. to devote added time to personal business, which will include service as a mining consultant. Mr. Leisk joined Sunshine in 1936, became general manager in 1954. At the firm's annual meeting last spring, he declined renomination to the board of directors in view of his "impending retirement." A recognized authority on silver, he was awarded an honorary doctorate last year by his alma mater, Michigan College of Mining & Technology. Before joining Sunshine, he was engaged in copper mining in Arizona and mine examination in Africa and South America.

David D. Baker has been appointed director of the mining division of the Grand Junction Operations Office of the Atomic Energy Commission. He joined the AEC in July 1954 as staff engineer in the exploration division and for the past 18 months has been deputy director and acting director of the mining division. He has held executive positions with Utah Construction Co., Union Mines Development Co., Pacific Mining Co., Alaska-Juneau Co., U. S. Vanadium Co., Big Horn Mining Co. and American Smelting & Refining Co. He is a graduate of the University of Arizona in mining engineering and metallurgy.

Joseph White has been appointed exploration geologist for Steep Rock Iron Mines, Ltd.

Charles Miron, former mining captain at Pickands, Mather & Co.'s Zenith mine, has retired and will make his future home in Norway, Mich.

Robert Simon of W. S. Moore Co., has been appointed resident engineer at Newton Falls, N. Y., where he will be in charge of exploration work on lands near Star Lake, where Jones & Laughlin Steel Corp. operates its large Benson Mines.

John S. Bonte has been appointed director of industrial relations for the Oliver Iron Mining Div. Prior to his promotion, Mr. Bonte was assistant director of industrial relations.

Herbert F. Byrne and **Louis J. Rohl** of the U. S. Steel Corp. have been appointed to the newly created positions of vice president of production planning and vice president and chief metallurgical engineer for the corporation. **Joseph M. Greer** was promoted from assistant to general manager-production planning.

W. P. Weber, administrative assistant to the general manager of M. A. Hanna Co.'s Minnesota mines since 1950, has been transferred to the Cleveland office of the company.

William A. Riner Jr., Cheyenne, Wyo., has resigned as president of United States Yttrium, Inc., and has been replaced by **Cecil R. Ozier** of Champaign, Ill. **Theodore H. Frison** of Denver has been named vice president to replace **I. W. Kinney,** resigned. U. S. Yttrium is engaged in research and development of the production of rare earths.

Anaconda Co. has announced a reorganization of its geological department. **V. D. Perry,** chief geologist for the company at Salt Lake City, has moved his headquarters to New York City at the firm's principal offices, 25 Broadway. **Roland B. Mulchay,** division exploration geologist at Tucson, Ariz., was promoted to assistant chief geologist at Salt Lake City. In this capacity, Mr. Mulchay will have supervision of company exploration activities in western U. S. and Mexico, supervision of geological work at company operations in Mexico and western U. S., outside of Montana. **James L. Kelly,** formerly a resident at Salt Lake City, will succeed Mr. Mulchay as division geologist at Tucson. He is former chief geologist of Anaconda's uranium operations at Bluewater, near Grants, N. M.

Richard S. Perkins of New York City, has been elected a director of Phelps Dodge Corp. Mr. Perkins is vice chairman of the board of the First National City Bank of New York, and president of City Bank Farmers Trust Co. His other corporate directorships include New York Life Insurance Co., Southern Pacific Co. and International Telephone & Telegraph Co.

Four new appointments in the eastern Mesabi district of Oliver Iron Mining Div. have been announced. **Charles R. Doane,** maintenance foreman-automotive; **Theodore J. Hanson,** maintenance foreman-cars; **William A. Raukar,** shop foreman, maintenance department and **Emil F. Tieberg,** shop foreman.

Robert C. Erickson has been named truck foreman for Oliver Iron Mining's Canisteo district mines.

DR. G. C. MONTURE has been elected vice president of Strategic Materials Corp., and of each of its subsidiaries. During the past 10 years he has been the official Canadian Government representative at a number of international conferences including the International Tin Study Group, the British Commonwealth Specialist Conference on Mineral Resources, and the U. N. Committee to Study World Resources of Iron Ore.

Adam A. Birnstihl, pit foreman at Oliver Iron Mining Division's Canton mine at Biwabik, has retired with a continuous service record of 32 years with the company.

Avery C. Adams, president of Pittsburgh Steel Co., has been appointed president of Jones & Laughlin Steel Corp. On Oct. 1 he succeeded **C. L. Austin** who became vice chairman of the board, and chairman of the finance committee.

Richard N. Harle, manager of Mufulira Copper Mines, Ltd., Northern Rhodesia, has been appointed assistant consulting mining engineer to five companies of the Rhodesian Selection Trust group. The companies concerned are Mufulira Copper Mines Ltd., Roan Antelope Copper Mines Ltd., Chibuluma Mines Ltd., R. S. T. Services Ltd. and R. S. T. Exploration Ltd. A majority interest in these mines is held by the American Metal Co. of New York. Mr. Harle's new duties begin January 1957.

Edward W. Ritz, a carpenter at the Hurley plant, Chino Mines Division of Kennecott Copper Corp. for more than 30 years, has retired September 1.

Neele E. Stearns has been elected to a new post of vice president for planning and development, Inland Steel Co., and **Lemuel B. Hunter** has been named assistant to the president. In his new office, Mr. Stearns will be chairman of the company's planning committee and of a newly created research committee, and is to have supervision of all studies relating to the future growth and development of the parent company, its subsidiaries and divisions. He previously had some of these responsibilities as vice president of planning and administration and assistant to the president. Mr. Hunter who has been president of the Inland Steel Container Co. division, will assume

Jenkins designed for trouble-free performance... a

STAINLESS STEEL "Y"

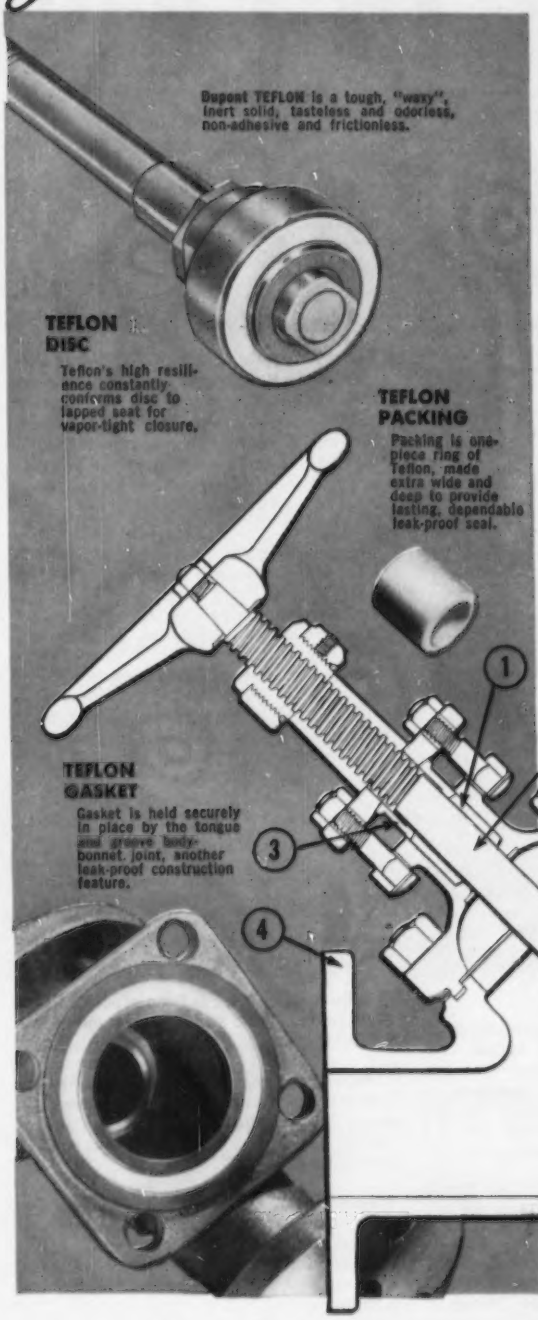
to lower costs in a wider range of

CORROSIVE SERVICES

For food and chemcial plants, and similar services, Jenkins Fig. 1335 "Y" Globe offers many advanced features that will lower operating costs and keep your processing lines trouble-free. The disc, packing, and gasket are tough, resilient Teflon. Tasteless and odorless, it eliminates problems of contamination.

The "Y" pattern permits full flow, nearly equal to that of a gate valve, and also provides the vapor-tight closure and the ease of disc renewal of a globe valve.

Fig. 1335 offers extra value by any test . . . *initial cost, operating efficiency, low maintenance.* You can convert this extra value into *extra savings* on your toughest corrosive services. Call your Jenkins Distributor, or write: Jenkins Bros., 100 Park Ave., New York 17.


Dupont TEFLON is a tough, "waxy", inert solid, tasteless and odorless, non-adhesive and frictionless.
TEFLON DISC
Teflon's high resilience constantly conforms disc to lapped seat for vapor-tight closure.
TEFLON PACKING
Packing is one-piece ring of Teflon, made extra wide and deep to provide lasting, dependable leak-proof seal.
TEFLON GASKET
Gasket is held securely in place by the tongue and groove body-bonnet joint, another leak-proof construction feature.
1
2
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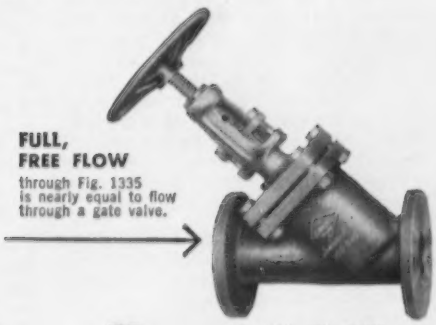

Fig. 1335 "Y" GLOBE
150 lbs. O.W.G. at 500°F
230 lbs. O.W.G. at 100°F
Sizes 1" to 4"

(1) Packing Box—Exceptionally deep and wide to hold optimum size packing.

(2) Spindle—Polished shank, long-operating threads, bevel shoulder for backseating.

(3) Gland—Two-piece for equalized pressure, tight seal.

(4) Flanges—Conform to M.S.S. Standard Practice S.P.42 Specifications.

JENKINS STAINLESS STEEL VALVE BOOKLET illustrates and describes wide range of Jenkins Globe, Gate, Check, and Y Valves, includes selection data, survey forms. Ask for Form 200-A.

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VALVES
SINCE 1864
TRADE JENKINS MARK
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PERSONALS *(Continued)*

CHARLES M. SCHILLMOLLER has joined the staff of the West Coast technical field section of International Nickel Co.'s development and research division. From 1952 until joining International Nickel Co. Inc., he served as a corrosion engineer with the Richfield Oil Corp., of Los Angeles, Calif.

the duties of assistant to the president which Mr. Stearns has carried since last January when that post was created.

William P. Reed, superintendent of Inland Steel Co.'s Bristol mine who resigned July 1, has accepted a position as assistant to the manager with Industrae Comercios de Minerious, Brazil, S. A. The company is developing an open pit manganese operation in northern Brazil. **Wayne J. Ahl,** former superintendent of Inland's Greenwood mine at Ishpeming, has succeeded Mr. Reed as superintendent of the Bristol mine.

Dr. Frederick M. Chase has been appointed assistant director of exploration for the M. A. Hanna Co. at the Cleveland office where he will work with **Dr. John K. Gustafson,** director of exploration.

Edward H. Brinley has been transferred as geologist from California to Lake Head, Ontario, by the Anaconda Co. (Canada) Ltd.

Harold Kirkemo, USGS staff assistant at Grand Junction for three years and chairman of the Grand Junction AIME chapter, has been transferred to the Washington, D. C. office as staff geologist.

Joseph H. Taylor, vice president and manager of Peru Mining Co. since 1940, has announced his retirement from active participation in the company's management. He will continue as vice president and serve in an advisory capacity. Mr. Taylor came to the Silver City area in 1937 from Chicago, where he had been chief engineer of the parent organization —Illinois Zinc Co.—for whom he constructed a huge zinc rolling mill. **J. W. Faust,** assistant manager of Peru, succeeds Mr. Taylor as manager of operations for the company and its subsidiaries.

Pacific Coast Borax Co. Division of United States Borax & Chemical Corp., has announced the appointment of **Lloyd L. Fusby** as Western manager, and **Roger W. Hinchman** as general sales manager. Mr. Fusby has progressively been superintendent of the Boron plant, production manager, and he will now have over-all responsibility for production at both Wilmington and Boron, as well as related activities of the division. Mr. Hinchman has been with the company since 1941.

Vernon R. Read has joined Columbia Iron Mining Co., Provo, Utah, as a raw materials engineer. Before joining the U. S. Steel subsidiary, Mr. Read was employed by Resources Development Corp. as a mining engineer.

Paul M. Tyman, formerly with Stearns Roger Mfg. Co., has joined the administrative staff of Potash Co. of America. **Robert J. Engelhardt,** former consulting engineer, has become staff engineer at the Carlsbad headquarters of the company.

Stockholders of U. S. Potash Co. approved a merger with Pacific Coast Borax Co., and **Horace M. Albright,** president of U. S. Potash, and **Thomas M. Cramer,** vice president, announced their retirement. The company resulting from the merger will be called United States Borax & Chemical Corp. U. S. Potash will be United States Potash Division of the new firm. **James M. Gerstley,** president of Pacific Coast Borax Co. will be new president. Other changes in the Potash Division are: **Dean R. Gidney,** vice president and general manager of the division, succeeding Mr. Cramer; **Earl H. Miller,** resident manager, succeeding **Henry H. Bruhn,** moved to the Borax Division.

Anson S. Bilger, president of General Monorail Corp.; **Fred E. Murrish,** engineer with the E. L. Doheny interests; and **B. M. Snyder,** consulting engineer and manager of Union Engineering Co., have been elected directors of Consolidated Virginia Mining Co.

H. L. Hazen, consulting metallurgical engineer for 30 years, and former consultant to the Atomic Energy Commission, has formed a new company to provide operating management for the uranium mills of his clients at 518 Farmers Union Bldg., Denver.

Richard J. Fisher has been named supervisor of industrial relations for the M. A. Hanna Co.'s Michigan district.

Dr. J. R. Van Pelt, president of the Montana School of Mines since 1951, has been appointed president of Michigan College of Mining & Technology, succeeding **Dr. Grover C. Dillman,** who retired October 1.

G. Keith Allen has been elected president of the Institution of Mining and Metallurgy, London, for 1957-58. **B. W. Kerrigan** has been appointed secretary of the Institute and will take up his duties immediately.

John E. Ellis, chief electrical engineer at the Crucible mine, has been appointed to the newly created position of superintendent of maintenance at the Crucible Steel Co. of America's Crucible mine.

DR. GORDON E. ZIMA has joined the staff of the Bayonne Research Laboratory of International Nickel Co., Inc., as a research metallurgist. He will work in the field of high temperature metallurgy, and on physical chemistry of the process of preparing alloys by melting under high vacuum.

Five new mining engineers and geologists have been added to the staff of Alcoa, Rosiclare Works. They are: **Eldred J. Kraemer, Jr.,** mining engineer, University of Pittsburgh; **John P. Meador,** geologist, University of Virginia; **Francisco N. Moreno,** mining engineer, Missouri School of Mines; **Ronald W. Schaefer,** mining engineer, University of Texas; and **Lloyd A. Smith,** mining engineer, transferred from Aluminum Co.'s Bauxite, Ark., plant.

John G. Trewartha, vice president and general manager of Ozark-Mahoning Mining Co., has retired and is succeeded by **Arthur G. Johnson,** chief geologist of the company.

John Vukmonich has been promoted to pit foreman at the South Agnew mine of M. A. Hanna Co.

Bruce Valine, mining engineer with San Manuel Copper Corp., San Manuel, Ariz., has resigned his position to join the M. A. Hanna Co. engineering staff at Hibbing.

Robert G. Dwyer has been named general counsel of Intermountain Area, for Anaconda Co., succeeding **C. Jay Parkinson,** transferred to New York as vice president and a director of Anaconda Aluminum Co.

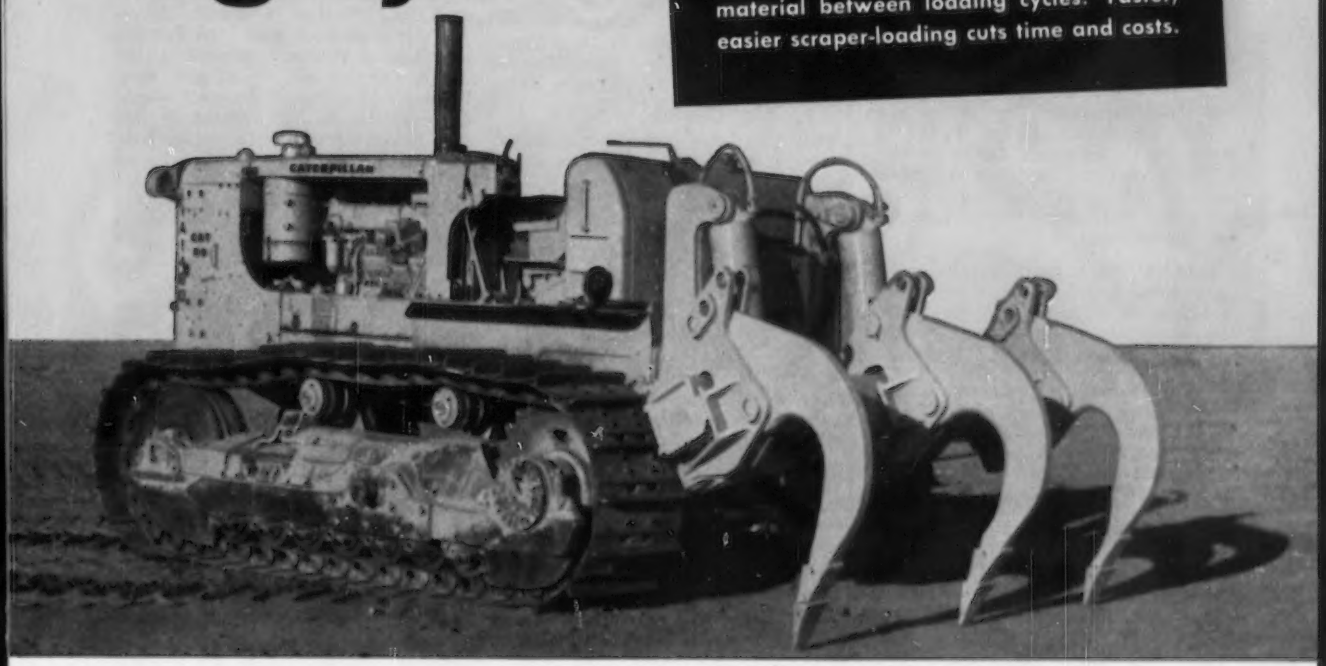
James E. Toepel, metallurgist, is now with the Erie Mining Co. research laboratory at Pickands, Mather & Co.'s Hibbing headquarters.

Donald F. Virant, mining engineer with Pickands, Mather & Co. has been transferred to the Hilton Mines, Quebec, Canada.

Ellis Maxwell has been named chief engineer for Pickands, Mather & Co.'s western Mesabi Range mines, succeeding

New CAT* No. 9 Ripper FOR THE Mighty D9!

First choice for push-loading, the D9 is now more versatile than ever. The new No. 9 Ripper lets the D9 rip tough or frozen material between loading cycles. Faster, easier scraper-loading cuts time and costs.



TRACTOR-MOUNTED

The tractor-mounted No. 9 Ripper utilizes the weight of the D9 to force the teeth into hard material. No need for ballast or extra weights. The hydraulically operated ripper affords maximum maneuverability because it is tractor-mounted.

"LIVE DRIVE" HYDRAULIC PUMP

New No. 50 Hydraulic Control has a constant power pump that supplies the capacity to raise or lower ripper teeth *independently* of flywheel clutch or torque converter.

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Shanks may be pinned in either of two ripper positions which provide either maximum ground clearance when raised or maximum penetration (up to 28") when lowered.

TRIPLE TEETH

Use one, two or three. Any or all of them can be swung up and pinned out of the way. Teeth pivot 10° to either side. This permits tractor steering and smoother ripping through rocks. Shanks are heat-treated alloy steel, with hardened alloy cast steel boots. Points are hardened cast steel, *pin-attached* for easy replacement.

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PERSONALS *(Continued)*

Richard J. Hawkinson who was transferred to Hilton Iron Mines in Quebec.

Richard B. Davern, supervisor of accounting for the Oliver Iron Mining Division, has been named assistant treasurer. **Thomas G. Barry** succeeds Mr. Davern.

Robert Y. Jensen, mechanical supervisor for the M. A. Hanna Co. Minnesota district, has been transferred to the Cleveland office. **John P. Vidmar,** district master mechanic for the Cuyuna Range, has succeeded Mr. Jensen.

Otto Holmquist has been named superintendent of the Great Northern Railway's ore loading docks at Allouez, Wis., succeeding **Thomas J. Greene,** retired.

Harland Stetson has been named assistant superintendent of Pickands, Mather & Co.'s Cuyuna Range district. Joining the company in 1950 as mining engineer, he became pit foreman at Tioga No. 2 mine near Grand Rapids, prior to this appointment.

Robert C. Smith, assistant treasurer of Chase Brass & Copper Co., a subsidiary of Kennecott Copper Corp., has been designated treasurer, succeeding **John H. Gilbert** who retired September 1.

Marlin R. Hemphill has been named general manager of the Forging & Casting Division of Allegheny Ludlum Steel Corp., Ferndale, Mich. He had been former general manager of the Carmet Division.

Robert P. Ogden has been named general manager of the Industrial Quimica Pennsalt S.A. de C. V., a new subsidiary of Pennsalt International Corp. in Mexico. He had been manager of Pennsalt's plant at Riverview, Mich.

A. L. Hayes will serve as manager, **R. E. Radabaugh** will be in charge of mining operations, and **K. C. Apland** will be mill chief of the Mexican Hat, Utah, uranium operation of Texas-Zinc Minerals Corp., a new corporation jointly owned by the New Jersey Zinc Co. and the Texas Co. Mr. Hayes will make his headquarters at Grand Junction, Colo.

John M. Cigan, graduate of Drexel Institute of Technology, has been awarded the graduate fellowship in metallurgical engineering by St. Joseph Lead Co. He will enter Carnegie Tech this fall.

James B. Bening has been named timber superintendent for the Bunker Hill Co., succeeding **Thomas Kinney,** retired.

OBITUARIES

Walter George Huseman, engineer in charge of development, Eagle Mountain Iron Mine, from 1947 until 1954, died in July following a prolonged illness, in Arizona. He was extensively known in mining circles for his frequent contributions to mining journals and his work for mine safety and health regulations. Prior to his association with Kaiser, Mr. Huseman had been an exploration consultant in mine development for the Tucson branch of the U. S. Bureau of Mines. His earlier mining experiences had been in the Coeur d'Alene, Grangeville and Hailey districts of Idaho and in Alaska.

Carl L. Modesitt, geologist and mining man, died recently in Denver. He was recognized as an authority on potash and other potassium carbonates, and helped develop much of the potash industry in the Rocky Mountain area.

Berne H. Hopkins, former operator on a lease from the Stratton Estate in Cripple Creek, and one of the Colorado area's oil pioneers, died recently of a heart attack.

Henry A. Saller, one of the country's leading authorities on materials used in the construction of atomic reactors, and recently named an assistant technical director at Battelle Institute, died August 14, apparently of a heart attack.

Oliver Eggleston, 79, retired mining engineer, died August 23. Since his retirement he had made his home at Carmel, Calif.

Henry W. Kaanta, 67, nationally known metallurgist, died September 4 at El Paso, Tex. Until his retirement a year ago, Mr. Kaanta was superintendent of the American Smelting & Refining Co. mill, built under his supervision at Deming, N. M. Before starting a 24-year career with AS&R, he was with Phelps Dodge Corp. for several years. He was a member of the AIME.

W. T. Simons, 73, president of Sidney Mining Co. of Kellogg until his retirement in 1952, died at his home August 14, following an extended illness. He was also a director of Sunshine Consolidated Inc. and its vice president for many years.

Robert Pruess, vice president and director of Continental Uranium Corp., was killed August 16, in an airplane wreck at Beaver Mesa, while in flight from Grand Junction, Colo. to Phoenix, Ariz.

Edwin J. Collins, 81, nationally known mining engineer, died suddenly August 15, in Hancock, Mich., while attending the 53rd reunion of Michigan College of Mining and Technology. He had served as vice president and director of the Calumet & Arizona Mining Co. prior to his retirement.

APPRECIATION

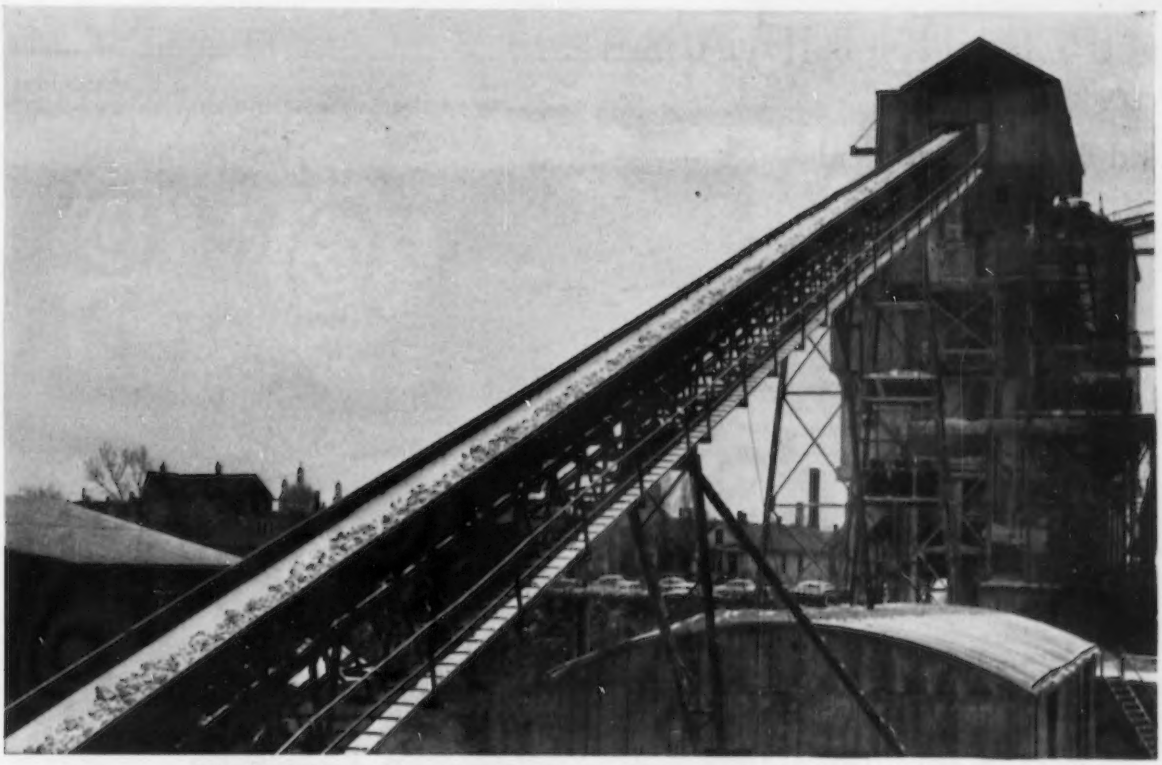
Charles Leighton Bradbury died April 3, 1956 in St. Petersburg, Fla. He was an owner of the San Pedro Mine Group, San Pedro, N. M., and long identified with mining in New Mexico. A past president (1942) of the New Mexico Mining Association and manager of mining enterprises in Mexico and Bolivia, he had many friends who respected him for his professional ability and integrity and enjoyed his personal charm and wit.

Mr. Bradbury served with distinction in France in World War I with the 29th Division and offered his services in the last war. He was a patriot, a respected citizen, and a Virginia gentleman of the old school. Born in Petersburg, Va., November 28, 1895, he joined the Richmond Blues and saw service on the Border in 1916 and, following World War I, attended the New Mexico School of Mines. He graduated in 1922 with the degree of Bachelor of Science and went to Leland Stanford University for a year's post graduate work. His first job took him to Mexico as engineer at the AS&R Charcas unit, S.L.P., and there he wrote his first professional paper, *Charcas, An Ancient District In San Luis Potosi, Mexico*. Returning to New Mexico to marry, he took his bride to the old gold-silver camp of Mogollon in that state, where he worked for a year as mine shiftboss, Mogollon Mines Co. But pull of far places was strong and he went back to Mexico to become superintendent of the Cabrestante Mines, Mazapil Copper Co., where the blood-stained floor in the quarters of his murdered predecessor evidenced the unsettled condition of Mexico in those years. From the Concepcion del Oro camp, he went to Cia. de Real del Monte as a Pachuca mine captain, and to Wadley, S.L.P., as superintendent and later manager for the Republican Mining & Metal Co.

Perhaps Mr. Bradbury's most noteworthy achievement followed his appointment in 1929 as manager of the Empresa Minera Huanuni and Empresa Minera Japo, both in the Oruro District of Bolivia. There he reorganized and rejuvenated the ailing tin properties of Simon Patino and put them on a profit making basis. On one occasion he flew to Paris in the Graf Zeppelin to confer with the mine owner, then the Bolivian Ambassador to France. Living at the altitude of 14,000 ft and operating mines up to 17,000 for seven years finally undermined the robust health of this rugged mining engineer and he returned to his beloved Virginia countryside to recuperate. In the East he met John J. Raskob and was persuaded to take over the management of the Raskob Mining Interests Inc., with properties in several Western states. From 1939 he concentrated operations at the San Pedro copper mine in New Mexico and, after several years of profitable operation, purchased this property from Mr. Raskob. Because of the fine record made at San Pedro, Mr. Raskob and his associate, Gen. Hugh Drum, appointed Mr. Bradbury vice president of a new mining and milling operation, Cia. Minera del Mexcala in Guerrero, Mexico, which position he held at the time of his death.

Mr. Bradbury is survived by his wife, Mrs. Marjorie Herrick Bradbury of Socorro, New Mexico, and his children, William, Emily, Marjorie and Nancy.

Col. C. F. Williams



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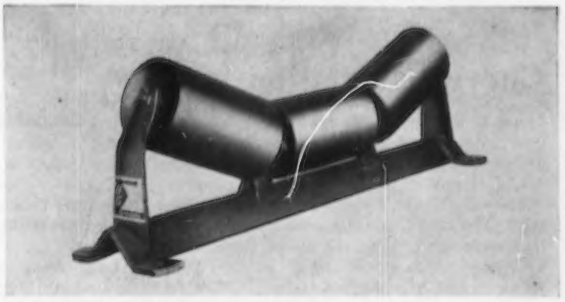
Installed 20 years ago, Barber-Greene Idlers are still rolling at this Material Service Corporation plant in Chicago.

There are no secrets behind the long-life records established by Barber-Greene Idlers. Advanced design plus top-quality materials, plus precision manufacture with the most modern production machines make the difference. The user benefits in lower maintenance costs, less down time, and longer idler life.

Barber-Greene advantages include virtually unbreakable jig-welded base frames, self-shedding base angles, interchangeable rolls made of heavy steel tubing, seamless steel grease reservoirs of ample capacity, and two-degree tilt to facilitate belt alignment.

Whether it's a ball bearing unit for normal service, or a roller bearing unit for the most rugged conditions, Barber-Greene has the idler that's right for any conveyor . . . right for any job.



Available in widths from 16" to 60", with 4", 5", or 6" rolls, the Barber-Greene line includes standard troughing carriers and return rolls, flat belt and picking table carriers, self-aligning carriers and return rolls, grain idlers, rubber impact carriers, and self-cleaning return rolls.

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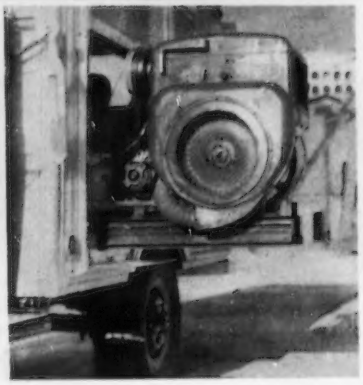


RESISTIVITY SURVEYS are facilitated with this truck-mounted set-up, according to Dr. A. W. Love of Newmont Exploration Ltd., Jerome, Ariz. In addition to this unit, a second one is operating out of Tsumeb, South West Africa.

In operation, up to 10-amp, 2,000v dc is applied to two steel source electrodes several hundred feet apart. A second pair of search electrodes measures voltage distribution and thereby locates electrically conductive zones in the earth.

Equipment is mounted in Frauhauf van body on 4-wheel Dodge Power Wagon. Lightweight 3-phase, 400-cycle, 15-kva, aircraft generator is driven by Wisconsin air-cooled gasoline engine. Pratt-Gilbert Hardware Co., Phoenix, Ariz., designed belt drive to give required 8,000 rpm on generator from engine's 2,000 rpm. The 120v developed is stepped up to 500 to 2,000v by a bank of transformers and then rectified with set of mercury vapor units and smoothed out with filters.

To cut fume and noise inside van, engine-generator is mounted on a ball-bearing sliding channel arrangement and can be cantilevered outside. Vertically sliding door seals opening.

Article in *Enginews*, a monthly issued by Wisconsin Motor Corp., Milwaukee, Wis., adds that the Tsumeb unit has special generator. Made by Georator Corp., Manassas, Va., it uses 28 permanent magnets on rotor direct connected to engine shaft. Belt drive is eliminated and the high-frequency alternator can be short circuited without damage.

Curve Calculation Is Easy

HERE IS A SIMPLE and reasonably accurate method for laying out underground curves. It was sent in by George T. Bator, associate professor, Department of Mining Engineering, Colorado School of Mines, Golden, Colo.

Drawing shows elements of problem. First controlling factor is Radius of Curvature—determined in many instances by haulage equipment specifications. Second factor, Chord Length, is normally based on length of drill round. Third factor is Angle I and if not known already, can be measured on map with protractor. In example given, Radius is 22 ft; Chord Length, 4 ft; and I, 48 deg 46 minutes.

For first step in calculating, circumference of circle ($2\pi R$) is divided by 360 deg to determine length of arc for one degree of curvature. Length of arc is then found by multiplying this value by number of degrees (angle I) involved in curve:

$$\text{Length of Arc} = \frac{2\pi(22)}{360} \times 48.77 = 18.73 \text{ ft}$$

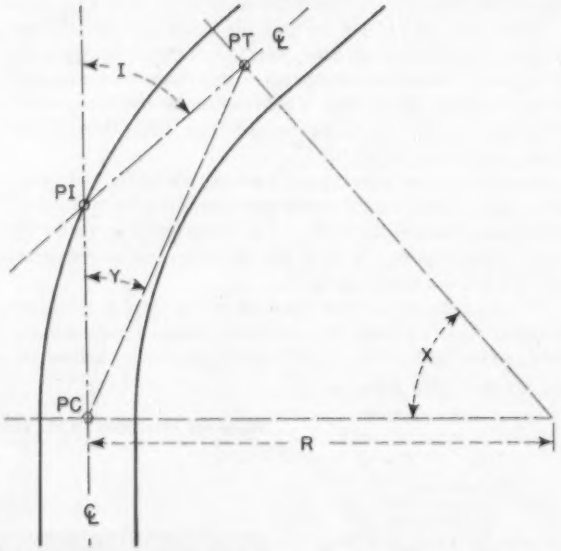
In second step, total deflection angle Y, which is ½ I, is divided by length of arc to determine deflection angle per foot of arc length:

$$\text{Deflection Angle per foot of Arc} = \frac{\frac{1}{2}(48.77)}{18.73} = 1.302 \text{ deg}$$

For final step, since short chords are nearly equal to arcs, multiply angle per foot of arc by chord length to get deflection angle per drill-round chord:

$$4 \times 1.302 = 5 \text{ deg } 12 \text{ minutes } 30 \text{ sec.}$$

Deflection angle from P.C. (where curve begins) to center of final face of each round is found simply by multiplying



total length of chords to face (arc length) by angle per foot of arc:

$$\text{For 2nd Round, Angle} = 2 \times 4 \times 1.302$$
$$= 10 \text{ deg } 25 \text{ minutes}$$

And so on for remaining angles. Last round, the fifth, is only 2.73 ft long so deflection angle is only 3 deg 33 minutes. Total angle (Y) from P.C. (18.73 x 1.03) equals 24 deg 23 minutes.

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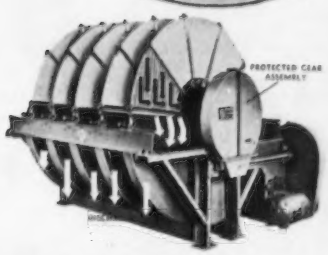

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- Drum Filters also available.

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Today's *new thickening techniques* require a new, high capacity thickener.

New flocculating agents that increase settling rates from 200% to 1000% mean *thickeners must move high tonnage* of fast settling solids and *handle overloads that build up fast.*

Faster settling takes place in less area and permits economy of smaller diameter thickeners.

SOLUTION

Spiral Rakes on DENVER *High Capacity* THICKENERS move solids to discharge in one revolution.

Completely automatic rake control handles overloads without attention and prevents damage to mechanism.

Low cost beam superstructure is used on sizes to 65' diameter. Simplified truss or bridge type is used from 65' to 125'.

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Every engineer planning a new thickener installation will want to study DENVER specifications. Compare sand raking capacity; shaft diameter; rugged, heavy-duty construction; totally enclosed, running in oil gears; automatic, foolproof rake lifting controls; acid-proof or standard construction; quick delivery.

You will agree the NEW DENVER *High Capacity* THICKENER more adequately meets ALL requirements of today's new thickening techniques.

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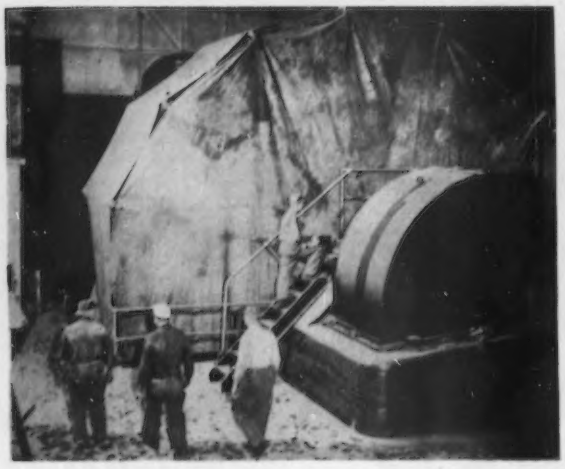
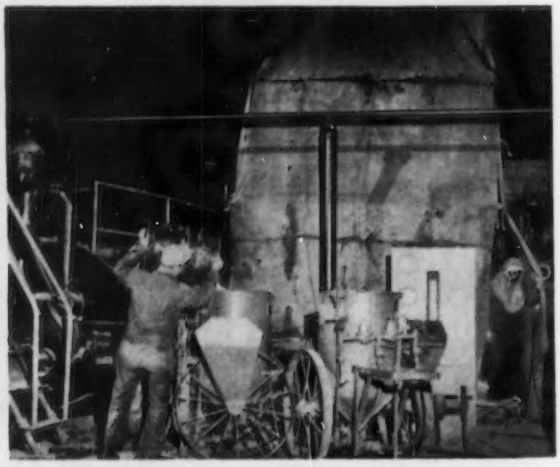




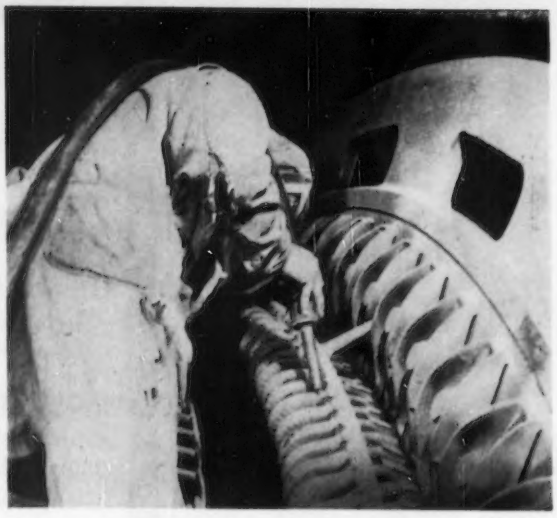
Clean Electric Motors Quick With Corncobs and Air

PORTABLE BLAST-CLEANING UNITS supplied with 20-mesh corncob grit and compressed air made a quick job of cleaning large electric motors and generating equipment at a steel mill.

Five men took a total of 500 man-hours to remove grease and dirt with usual scrapers, solvents and rags. Seven men with two blast cleaning units cut this labor to 200 man-hours—a 60% saving.

First, rotor and stator were shifted enough apart to expose areas to be cleaned. Then locally made canvas "tent" was erected over machine to confine grit. Next, blast cleaning units were hooked to 90 to 100 psi compressed air line and filled with grit. On relatively soft parts such as windings, 20 to 25 psi air was applied. On other surfaces 55 to 60 psi was used. Grit was recovered, screened and reused. Final step was blowing generator clean with air alone at 20 to 25 psi.

Compressed Air magazine reports special nozzles were locally devised to get into tight places.



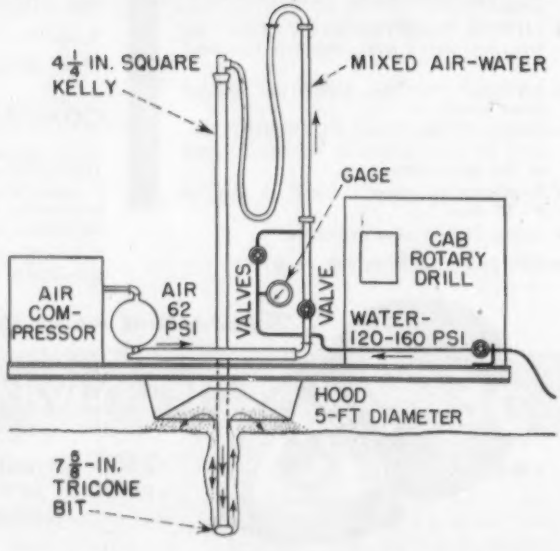
Water Kills Dust From Rotary

WATER INTRODUCED into compressed air line of large rotary air-flush drills can put an end to some discontent voiced by a number of users in the Southwest—that standard dry dust collectors are bulky, complicated and often inadequate.

William P. Crawford, Crawford Drilling Co., Phoenix, Ariz., says at one pit, penetration rates of 30 to 60 fph gave stack dust discharges that exceeded maximum dust count allowed by Arizona Dust Code and presented serious health hazard to personnel. Glenn Simon, a former general pit foreman, suggested adding water to flushing air. At small cost, this recommendation reduced dust count to very low figure.

Water is introduced into compressed air standpipe at pressure about double that of air entering kelly. Regulation is by needle valve and water is added until dust disappears. Amount varies from one quart to one gallon per minute; in damp ground no water is needed.

Drill hole is covered by conical hood 5 ft in diameter with hole at apex for drill rod. Hood is attached to rig frame and bottom edge is about 1 ft above ground. Dust and cuttings strike hood and pile up around collar where they are available for stemming and sampling.



Quebec, Canada . . .

another example of how Bucyrus-Erie rotaries cut costs on blast hole drilling jobs

On August 28, 1954, Iron Ore Company of Canada put a Bucyrus-Erie rotary blast hole drill into operation at Knob Lake in Quebec. The material there consists of up to 63% iron and 2½% to 12% silica, with overburden made up mainly of non-formation and dolomites. The iron contains approximately 20% hard iron formation and the balance is limonite and hematite.

After a preliminary survey of the property, the 50-R was tried at three locations. The first of these was on the south ore body where drilling was hard, heavy, and in broken formations and ravelly bands about ½ an inch thick. The second was on the north ore body where drilling was medium hard to soft and the material varied both vertically and horizontally. The third was in a quartzite type of material which resembled sandstone, but was heavier than sandstone because of the impregnation of iron ore. All three locations were within a one-half mile radius.

Results in feet per hour of drilling time were greater than expected. The overall figures are given in the accompanying table.

Due to the impressive performance of this 50-R, Iron Ore Company of Canada has since ordered five more . . . further proof that these drills really pay off. To find out how they can benefit you, write today to BUCYRUS-ERIE COMPANY, South Milwaukee, Wisconsin. Ask for detailed specifications and illustrated literature.

37B56C

PERFORMANCE DATA TABLE

TIME	8/27 - 10/1	10/1 - 11/13	8/27 - 11/13
Footage drilled	5,725'	7,145'	12,870'
No. of holes	177	211	388
Ave. hole depth	32.3	33.8	33.3
No. of days	31	40	71
Ft. per hr.—drilling time	57.0	67.7	62.5
Ft. per shift	184	178	181

BUCYRUS ERIE

SOUTH MILWAUKEE, WISCONSIN

NEW BOOKS

Assay Practice on the Witwatersrand, by V. S. Dillon. Here is a complete run down on how to design and use an integrated assay office by the men who use the equipment and do the work. The first four chapters discuss layout and design and then the authors turn to the following:

Crucible assay theory and practice, sampling, ore analysis, solution assay, sizing and bullion assay. Methods used to assay by-products, complex gold ores, air and gas analysis, pH determinations, electrometric titration, analysis and treatment of water are also described.

Chapters are set aside to cover coal, coke, mine stores (including Kaffir beer), tin, lead, iron, base metals, other precious metals, cyanide solutions and sulphur. Still further chapters cover the testing of a gold ore for extraction, the analysis of uranium and the individual rare earths, coulometric and polariographic analysis.

This reference book is a revised and improved edition of *Rand Assay Practices* and was authorized and published by the Council of South African Assayers with the financial assistance of the Transvaal and Orange Free State Chamber of Mines.

This complete gold plant assay manual contains information of interest to assayers old and new. It can be obtained from Central News Agency, Ltd., Rissik & Commissioners Streets, Johannesburg. Illustrated in 586 pp. Price 46/6.

Science and the Economic Order, compiled by Metallgesellschaft AG in celebration of its 75th anniversary. This handsome leather-bound volume contains nine lectures by leading German scholars, expressing their viewpoint on the theme—science and the economic order. Published in the English language by Metallgesellschaft AG, Frankfurt Am Main. 248 pp.

Why D-C?, by members of General Electric Co., direct current motor and generator depts. With the tremendous rise in the use of d-c equipment since 1940, GE has prepared this non-promotional booklet for the general public to explain why d-c is not out of date, but the motor driving force of tomorrow. It can be obtained from E. A. Baily, Jr., General Electric Co., Erie, Pa. 32 pp.

Pick's Currency Yearbook, 1956, by Franz Pick. This is the successor to his *Black Market Yearbook* and in this issue it carries detailed statistics on free market currency movements. Published by Pick's World Currency Report, 75 West St., New York 6, N. Y. 476 pp. Price $35.

Technical Reference Book, by British Compressed Air Society. This is the 26th year for this standard data book on compressed air units. It will answer all the questions you may have on requirements, materials, British standards for compressed air, etc. Published by British Compressed Air Society, 32 Victoria St., London, S. W. 1. 106 pp. Price 20/.

Effect of the New Tax Depreciation Methods on the Earnings of Depreciable Assets, by George Terborgh. Published by Machinery & Allied Products Institute, 1200 18th St., N. W., Washington 6, D. C. 23 pp. Price $1.

The Potentials About a Point Electrode and Apparent Resistivity Curves for a two-three-and four-layer earth, by Harold M. Mooney and W. W. Wetzel. Published by the University of Minnesota Press, Minneapolis 14, Minn. Tables and introduction to the use of approximately 2300 curves. Set of curves and 145 pp text. Price for complete set is $18.

Engineering as a Career, by Ralph J. Smith. Written to introduce the college freshman to the engineering profession, it covers types, duties, salary ranges, and includes a section on typical problems encountered in the various branches of engineering. Published by McGraw-Hill Book Co., 330 West 42nd St., New York 36, N. Y. Illustrated in 353 pp. Price $4.75.

Reports and Bulletins

Geological Reconnaissance of the Cassia Mountain Region, Twin Falls and Cassia County, Idaho, by Walter Youngquist and Jerald R. Haegele. Also entitled Pamphlet No. 110 and published by Idaho Bureau of Mines and Geology, Moscow. 18 pp.

Geology and Mineral Resources of Nez Perce County, by Charles R. Hubbard. Same address as above. 17 pp.

Geology of the Lower Pipstem Creek Area, North Dakota, by Ronald J. Kresl. Report of Investigation No. 25 for the North Dakota Geological Survey, Grand Forks. Map.

Geology of the Grassy Butte Area, McKenzie County, North Dakota, by Elmer G. Meldahl. Same address as above. Map.

Mississippian Stratiographic Studies, by Sidney B. Anderson and LaVerne B. Nelson. Same address as above. Map.

• The following free Circulars, published by U. S. Geological Survey, can be obtained from Geological Survey, Washington 25, D. C.

Circular 296, Stratiography of the Wasatch Range Near Salt Lake City, Utah, by Arthur E. Granger. 14 pp.

Circular 304, Stratiographic Section of the Phosphoria Formation in Idaho, 1949, Part 1, by R. P. Sheldon, M. A. Warner, M. E. Thompson and H. W. Peirce. 30 pp.

Circular 303, Stratiographic Section . . . Idaho, 1949-50, Part 2, by R. W. Swanson, E. R. Cressman, R. S. Jones and B. K. Replagle. 21 pp.

Circular 305, Stratiographic Section . . . Idaho, 1949, Part 2, by D. F. Davidson, R. A. Smart, H. W. Peirce and J. D. Weiser. 28 pp.

Circular 307, Stratiographic Section . . . Wyoming, 1949-50, by R. P. Sheldon, R. G. Waring, M. A. Warner and R. A. Smart. 45 pp.

Circular 309, Beryllium Resources of the Tin-Spodumene Belt, North Carolina, by W. R. Griffiths. Maps and 11 pp.

Books presented on this page are available through the publishing house mentioned in connection with the individual literature. *Engineering & Mining Journal* does not sell or offer any literature presented here unless specifically noted.

WASHINGTON IMPACT

CAT* Motor Graders—now more than ever PROFIT MAKERS FOR YOUR MINE

This Caterpillar No. 12 Motor Grader works two shifts a day, six days a week the year around for the Tecumseh Coal Corp. of Boonville, Ind. Around-the-calendar Caterpillar dependability is traditional in mining work, where these versatile yellow motor graders find wide application in haul road construction and maintenance, snow removal and cleanup.

There are three Caterpillar Motor Grader models: the heavy-duty No. 12 with exclusive oil clutch, the No. 112, and the compact No. 212. Any one of them can reduce wear-and-tear on hauling equipment and step up cycle times with fast, smooth haul roads in *your* mine.

In the long run, Caterpillar Motor Graders cost *less* than other makes. Their economical, four-cycle diesel engines deliver full and foul-free power on inexpensive, non-premium furnace oil. Rugged construction and Caterpillar craftsmanship keep them on the job and out of the shop, and give them high resale value.

All Caterpillar Motor Graders are now available with tubeless tires at no extra cost. Tubeless tires save the cost of tubes and flaps, eliminate 80% of tire down time, and deliver longer casing life and more recaps because they run 10 to 15 degrees cooler.

Caterpillar Motor Graders are built—not merely assembled—by a single manufacturer. Engine power, blade capacity and working speed are carefully matched for maximum efficiency and long work life. All parts and service are available from one dependable source: your Caterpillar Dealer. Ask him to demonstrate the excellent visibility, quick-acting, positive controls and balanced traction that will make a Caterpillar Motor Grader the fast-working favorite of operators in *your* mine.

Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

CATERPILLAR*

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

99% OF ALL CAT MOTOR GRADERS EVER BUILT ARE STILL IN USE

Protective Trade Winds Blow Stronger

U. S. TRADE POLICY WINDS are shifting subtly on several fronts. For more than 20 years they have blown steadily in the direction of liberal international trade, economic cooperation and low tariffs. Now, there are strong counter-pressures for more protection of domestic industries against foreign imports. It's too early to tell whether a real storm over liberal-vs-protectionist trade philosophy will develop, and if so what effect it will have on the direction of U. S. policy. But a disturbance is brewing, centered in Washington—where opposing pressures from grassroots areas where basic raw materials are produced, processed, or consumed are reflected in the political atmosphere by a sharp split within both Congress and the Administration.

The fight is an old one to the metals and minerals industries, where producers and processors of some of the most elemental items to international trade have argued protection vs free world markets for years. Now, with a national election coming up, everyone in the capital is talking about the pros and cons of liberal trade. Here are some straws in the wind:

Suez—Never before has a headline international political event so dramatized the importance of world trade. Protectionists and free traders alike, in industry and government, are using Suez as a forum for their arguments (*E&MJ*, Sept. '56, p121). Because of the canal's significance to minerals imports, most mining spokesmen in the field and in Congress are pointing to the possible cutoff as an argument in support of a more independent domestic industry. State Department career men, and many metals processors, on the other hand, are citing Suez as an indication of our stake in a free, economically sound southeast Asia.

Political Party Planks—The rising protectionist sentiment can be best shown in the platform foreign trade policy planks of the two major political parties. The Republicans point with pride to the escape clause and peril-point restrictions on reciprocal trade which were written into trade laws under their previous administrations. And for the first time, the traditionally liberal trade Democratic party, author and sponsor of reciprocal trade programs, gives a tip of its hat to protectionism by citing and promising to correct alleged inequities to domestic industry agriculture and labor which, the plank accuses the GOP of allowing to occur. Both parties, however, give at least lip service to reciprocity.

Defense Essentiality—This is a new provision for tariff relief tacked on the extension of reciprocal trade laws by the last Congress. It allows the Office of Defense Mobilization to recommend to the White House quotas or higher duties, escape clause or peril-point relief, for any industry vital to the national defense which can make a case that foreign competition is hurting national security. Liberal trade proponents on Capitol Hill, particularly the Democratic leadership of the Foreign Policy Subcommittee of the Joint Congressional Economic Committee, headed by Rep. Richard Bolling (D-Mo) and Sen. Paul Douglas (D-Ill) have attacked this provision, urged it be used at least cautiously, and have several times tried to pin down ODM Director Arthur S. Flemming and other defense chiefs on how the Administration plans to define "defense essential." Government spokesmen, however, have refused. They want to decide each case on its own merits.

The first of 11 applicant industries for this avenue of relief (previously open only through the Tariff Commission) came up for hearing late last September. This was the appeal of domestic sisal cordage producers. They were opposed by importers, who asked that the defense essentiality provision be thrown out as an unconstitutional delegation of Congressional trade authority to an administrative agency (ODM, of course, will not attempt to rule on the legality of the new clause). Domestic fluorspar producers have also asked for an ODM determination, but are holding up their hearings until they see whether the new Government purchase programs will make more tariff relief unnecessary.

Congressional Hearings — Perhaps the most far-reaching forum for the trade policy underway in the House Ways & Means Committee. A subcommittee under the chairmanship of Rep. Hale Boggs (D-La) is holding hearings on all aspects of U. S. trade policy—tariffs, customs and other trade laws. As this issue went to press, witnesses ranging from academicians to businessmen to Government consultants and career administrators were having their say. But the protectionist-minded were talking the longest and the loudest.

Counterbalancing the conservative trend that grows more and more evident in discussions of the above factors, is the Administration's committment to such programs as barter of agricultural surpluses for foreign minerals (on the upswing as reported earlier in these columns), a minimum of export controls except on particularly tight items such as nickel, continued reciprocity, and international economic cooperation to help keep the free world nations as strong as possible.

But within both political parties other producers (such as textile manufacturers) are joining metals and minerals mining in bringing pressure to at least end the 20-year trend toward lower tariffs. The rounds of Geneva duty cuts (General Agreement on Tariffs and Trade) are over U. S. membership in the organization for trade cooperation. The international group proposed to police GATT policies and agreements is undecided until Congress acts next session.

The U. S. is unlikely to relinquish its position as number one liberal international trader. Nor is a divided Congress and Administration likely to reverse its whole trade policy. However, an "agonizing reappraisal" could easily precipitate some changes.

Chrome Barter to Aid Turkish Mining

NEW FIGURES recently released by the Agriculture Department's barter division indicate the upswing in this Government activity. The figures apply only to what agriculture acquires for the so-called supplemental stockpile, the stocks that are aside from defense long range or short range requirements, and which may not be released on the open market without specific Congressional approval.

For July, 1956, the department barter program for the supplemental stocks totaled $15.3-million, as follows: Beryllium-copper master alloy—$9.9-million; manganese ore — $3.4-million; mica — $1.2-million; and cadmium—$800,000.

For the fiscal year 1956, ending last June 30, the breakdown is: Total—$104.9-million. Bismuth—$900,000; cadmium—$5.1 million; industrial diamonds — $26.2-million; ferrochrome-silicon — $10-million; ferro-manganese—$46.1-million; fluorspar—$11.8-million; manganese ore—$200,000; mica—$700,000; palladium — $1.7-million; and rare earths — $2.2-million.

This means that all the lead and zinc barter deals previously reported in these columns is headed for the defense stockpiles.

Also, Agriculture announced a deal to help solve a shaky situation in Turkish chrome. Turkey, one of the U. S. prime importers of the metal, had trouble getting proper mining equipment and in financing production already contracted. Agriculture has now offered to barter $15-million worth of surplus U. S. wool for Turkish chrome ore meeting stockpile specifications.

The program is expected to provide Turkey with enough wool to sell or barter in turn above its own needs, and stimulate chrome production.

John C. L. Donaldson

Nickel Aid Spurs Others to Seek New Expansion Goals

IN LIGHT OF A NEW GOVERNMENT OFFER to help carry "unusual" nickel development costs, several firms are reported dickering with General Services Administration for contracts. The help will be given in the form of price supports to cover the development costs.

Meanwhile, ODM is studying all expansion goals with a cautious eye towards revising them upwards. Pressure from steel and nickel users have brought about this shift from ODM's previous bearishness on tax aid.

Office of Defense Mobilization has closed down the 35,000-ton goal for production of rutile on which it will give fast tax writeoff help. While U. S. production hasn't yet hit this figure, ODM says foreign and domestic sure sources of rutile, ilmenite, and titanium slag are sufficient to meet defense requirements for titanium, in which rutile is one production factor.

On the other hand, a new expansion goal for titanium itself is still in the works, and so are others for similar "atomic" metals and minerals.

Late Developments

UNEMPLOYMENT in mining has fallen nearly 1% since the first of the year, according to new labor department statistics on the characteristics of the unemployed. Following a national trend for the first six months of 1956, the rate of unemployment in the mining industry declined from 4.6% in January to 3.7% in June by mid-year, 28.1 thousand miners were jobless. However, their average length of unemployment was 9.3 weeks, second only to Government workers in duration.

These statistics are part of a new series of monthly reports collected by the Bureau of Labor Statistics together with state unemployment compensation officials and represent a 1% sampling of all jobless workers applying for unemployment insurance benefits.

The national unemployment pool showed a drop from 1.4-million to less than 1.2-million, the purpose of the study is to go deeper into who make up the unemployed group, however. The study is still too young to show definite trends other than seasonal factors, but unskilled workers and women are proving to be the first to be laid off.

Labor undersecretary Arthur Larson, a leading spokesman for the "New Eisenhower Republicanism" who sponsored the study, hopes to find clues to new social legislation and administrative programs such as retraining courses as a result of the surveys. He also thinks its findings will help refute Democratic political charges that the GOP is unconcerned with unemployment.

Labor This Month

LABOR'S NEXT TARGET—THE SHORTER WORKWEEK: Number one on the list of organized labor's demands of the future is the reduction of working hours, with no loss in take home pay. This drive is now being plotted in the wake of 1956 contract settlements which insure long-term peace in copper, steel and other major industries. Union strategists want to be ready for the next collective bargaining go-round and the spare time ahead will be used to plan the shorter workweek campaign. The idea is to make this the next victory in a bargaining sequence that started a decade ago with pensions and has run through the guaranteed annual wage.

MINE-MILL WILL JOIN THE SHORTER-HOUR DRIVE: While the International Mine Mill and Smelter Workers union is barred from the merged AFL-CIO, its officials will be watching the strategy moves of the federation with the same idea in mind—to secure a cut-back in working hours. And, like the giant AFL-CIO auto and steel unions, Mine-Mill is settled under a three-year contract which means some long-term planning and delayed results. For all three, the next target is fewer working hours, with these positions firmly held: that there must be no drop in take home pay when hours are reduced (an 11c hourly pay hike is needed to offset a two-hour reduction for a 40-hr employee making $80 a week); that the goal must be achieved at the bargaining table because there's no hope for Federal legislation reducing the 40-hr standard; that the shorter workweek is needed to spread the work in the face of advancing automation and job reduction.

SHORTER HOURS—HOW TO DO IT: While the limited advance of the shorter workweek has come almost entirely with daily reduction in worktime, there are many other ideas being discussed in labor circles for achieving the same thing. So far, the five-day week has held up in textile and printing industries where the shorter workweek is farthest advanced while the daily time on the job has been sliced. The next most prominent way of winning more leisure time is through longer vacations and more holidays. But this doesn't fully answer the problem of providing more jobs, though it does mean more time off.

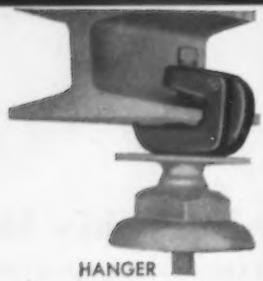
Two novel systems have been dreamed up by labor planners, more as an idea of what might come than as possible targets of the future. One suggestion is for a three day week end, with the cost to the employer estimated at a 25% increase for the worker to maintain his take-home pay. A second proposal would provide a one-year leave for an employee at about 50 or 55 to give him a taste of future retirement. The cost of this plan is estimated at one-hour a week for the entire working life of the employee.

FIRST TARGETS FOR THE NEW BARGAINING CAMPAIGN: Some of the heaviest ammunition for the workweek cutback will come from the giant industrial unions of the auto, steel and copper industries. But they are held partially in check by long-term contracts, though they will be part of the initial planning. And, as a practical matter, these industries may be more difficult attack targets than others. The strategy of labor at this point is to find most likely targets—prosperous industries threatened with technological unemployment but where the workers are receptive. This latter issue is important. First gains are expected to come in those industries which employ women, predominately. Women are considered especially receptive to shorter working hours in order to have more time for household chores.

One major concern of labor planners is that a segment of workers won't go for the shorter workweek. Current experience in the rubber industry shows that 6-hr-a-day employees, in some cases, also have full-time jobs elsewhere. And some unionists believe workers would prefer overtime pay to time off. General consensus is that lower-paid employees prefer overtime work; higher paid would take the leisure time.

Alan E. Adams

INSULATED HANGERS 1



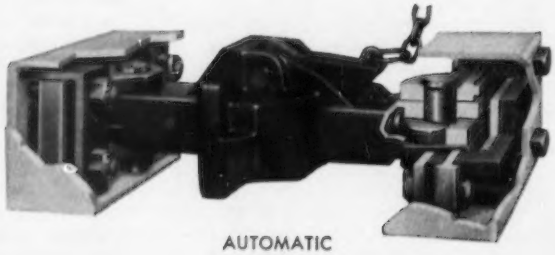
HANGER ADAPTERS 2

TROLLEY WIRE CLAMPS 3

FEEDER SLINGS 4

TROLLEY FROGS, CROSSOVERS 9

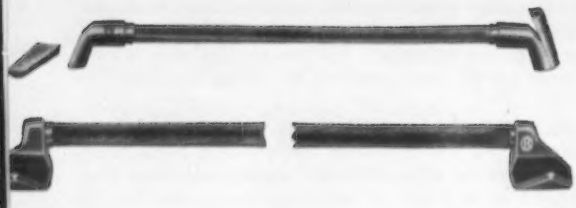
EXPANSION BOLTS 10



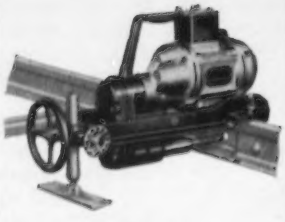
AUTOMATIC COUPLERS 11

Ohio Brass - First in

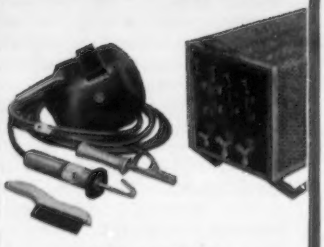
LOCOMOTIVE EQUIPMENT | LINE MATERIALS | RAIL BONDS



RAIL BONDS 15



RAIL DRILLS (for wedge bonding) 16



BOND WELDING EQUIPMENT 17

WHEEL COLLECTORS 19

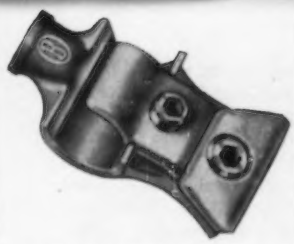
TROLLEY WIRE CONDITIONING EQUIPMENT 20

FUSED TAPS 21

New Era in Nickel

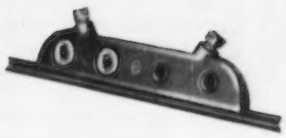
must be a producer of nickel second

became interested in the possibilities of



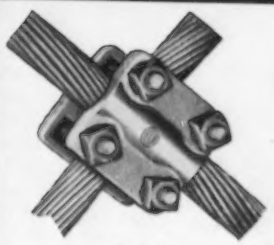
COMBINATION FEEDER-TROLLEY CLAMPS

5



FEEDER AND TROLLEY SPLICERS

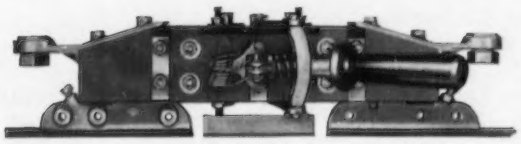
6



BRANCH CONNECTORS

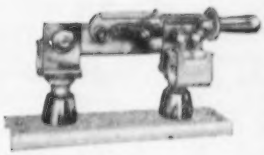
7

PORCELAIN INSULATORS



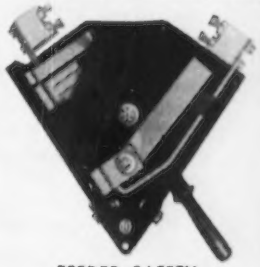
SECTION INSULATOR SWITCHES

12



QUICK-BREAK SWITCHES

13



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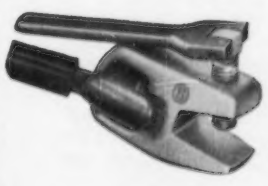

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New Era in Nickel

(Continued from p 75)

Inco sells most of its metal for 64½c a lb, nickel is selling higher in the free world market. The U.S. Government itself has made purchase contracts at higher prices.

In recent testimony before a congressional committee, a representative of the Department of Commerce stated that the Government is now paying Inco about 90c a lb under a special contract which was entered into in 1953 covering the delivery, over a period of time, of 120-million lb. It was also stated that the Government is presently paying Falconbridge $1.045 a lb under a contract covering 100-million lb of nickel being delivered over a period of years.

It is my understanding that the Government has a contract with a subsidiary of M. A. Hanna Co. for the purchase of nickel in the form of ferro-nickel covering deliveries over a period of years. A sliding scale of prices is provided, going up to as much as $1.44 a lb of contained nickel. In the world market, nickel has been selling for as high as $3 a lb.

What About Supply?

In the light of such a picture—a metal of the greatest importance to defense and industry; in short supply; and with increased demand predicted, the question is, "Where in the world are the nickel reserves from which more nickel can be developed and produced?"

Inco, in its 1955 annual report, stated that its proven reserves were 262-million tons and that it mined in 1955 about 14-million tons of ore, thus giving that company a proven life of about 18 years.

There has been a good deal of talk in the press about a new project of International Nickel Co. in northern Manitoba, about 400 miles north of Winnipeg, in the Mystery Lake-Moak Lake area. I believe this project to be of such significance that I should not attempt to give a complete picture of the world nickel situation without referring to it, even though there has so far been little in the way of authoritative statement from the company itself. On the 26th of July, the *New York Times* carried an article saying: "Top officials of International Nickel Co. are optimistic about the possible development of a $140-million mining center in the wilderness of northern Manitoba." The article then quotes H. S. Wingate, president of Inco, as saying, "To be economical, the Manitoba mine must be a producer of nickel second only to the company's Sudbury, Ontario, property which turns out 65% of the world's nickel." Then continuing, he said, "It still was too early to tell whether International Nickel would go ahead with the Moak Lake mine. Right now we haven't got enough workable tonnage to support a mine but we're hopeful that we will have by the end of September."

Falconbridge is the second largest producer. In its 1955 annual report it was stated that developed and indicated ore totaled 40-million tons of 1.43% nickel and 0.73% copper. It mined last year 1,678,000 tons so that its proven and indicated life would seem to be about 24 years at the present rate of production.

Sherritt Gordon Mines, Ltd., is a new Canadian producer. Its proven reserves were stated in its 1955 annual report to be 14-million tons of 1.15% nickel and 0.59% copper. At last year's mining rate of 761,000 tons, that would indicate a life of about 18 years.

Others. Nickel has been produced for many years in New Caledonia and production has also been secured in the Union of South Africa—both of these figures have been shown on the chart. There are unworked nickel deposits in the Philippines, in Indonesia, in Brazil, in Venezuela, as well as reported occurrences elsewhere.

And Cuba. The Office of Defence Mobilization recently caused a special study of nickel to be made by Dr. John R. Townsend. Dr. Townsend reaches this conclusion: "Where U. S. production is of minor character and Canadian production inadequate for all needs, it would appear that in the long view the U. S. would have to look more and more to Cuba as a source of nickel. The adequacy of the ore deposits, the ease of surface mining and the logistical advantage over production in the Philippines, Celebes and New Caledonia would support this view, and once plants are established they would be readily capable of expansion. Estimates of nickel content of Cuban laterite ore reserves approximate 24-million tons, equal to two centuries' consumption by the U.S. at the current rate of usage."

The President's Materials Policy Commission, in its report issued in 1952 (the Paley Report), estimated Cuban reserves at 25-million tons of contained nickel and it estimated Canadian reserves at 4-million tons of contained nickel.

Early Cuban Finds

Pardners Mines, a group that early became interested in the possibilities of producing nickel from Cuban laterites, proved up some 10-million tons of nickel ore at Moa Bay in the late 1930's, but found greater and more accessible deposits 40 miles to the west where they established the existence of some 30-million tons, averaging 1.46% nickel. It became apparent to Pardners Mines that development should be undertaken by a company with an operating organization preferably with some experience in Cuba. This the Freeport Sulphur Co. had as a result of its manganese operations in that country, and arrangements were accordingly made to interest Freeport in the project.

As Pardners Mines had discovered, one of the characteristics of the orebody at Nicaro was that there were two separate types of ore, a limonite lying quite near the surface running about 1.25% nickel and about 45% iron which was underlain by a zone of altered serpentine running up to 1.6% nickel but down to 12% iron. It was obviously desirable to work out a process which would recover the higher nickel values in the serpentine as well as the lower values in the limonite. We searched the literature and found that there were various processes that might be suitable to extract nickel from these lateritic ores. One of these was the carbonyl process in which Pardners Mines had been interested. This process proved unsatisfactory as did another involving leaching with sulphuric acid.

The literature search, however, had turned up some work done by a Dr. Caron of Holland on an ammonia leaching process. Dr. Caron had taken out some patents in the early 1920's but had never carried out his work beyond the laboratory or very small pilot plant scale. Nevertheless it seemed to use to offer possibilities and we went to work to try to adapt the ammonia leaching technique to the recovery of nickel from the limonite and serpentine.

We had had a one-ton incomplete pilot plant under way for three or four months when Pearl Harbor day came. At this point, it was obvious to all concerned that the war effort was going to need additional nickel and an arrangement was made with the U. S. Government for the immediate construction of a plant in Cuba. At the same time, Pardners Mine sold its interest to Freeport getting back its original investment plus a profit in Freeport stock.

A letter of intent covering these arrangements with the Government was signed in February 1942 and engineering plans were immediately commenced for a plant designed to produce 32-million lb of nickel a year in the form of nickel oxide. Ground was

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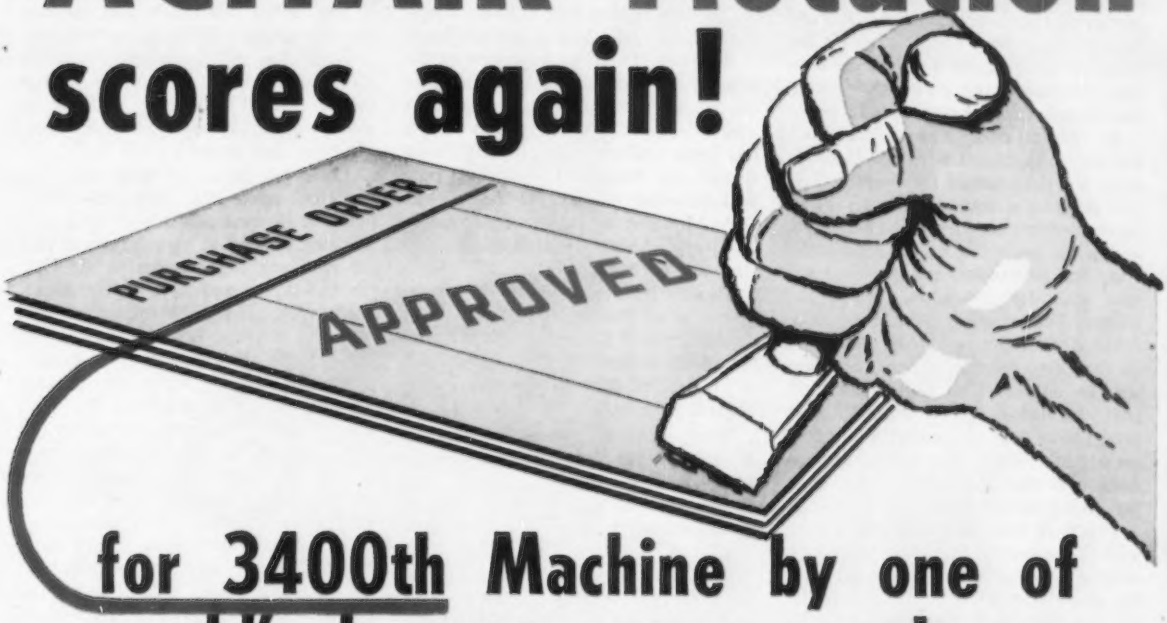

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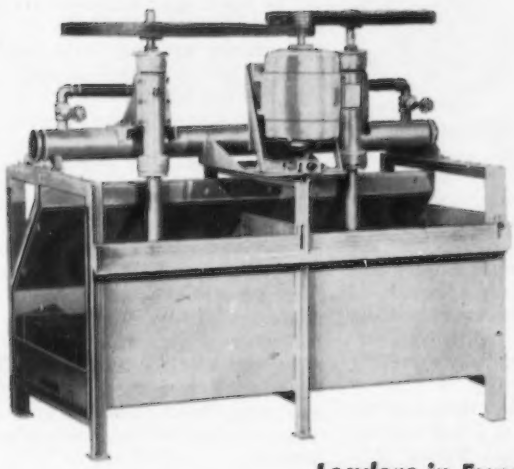

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broken in July of that year and the ore started into the first section of the plant in October 1943. A small amount of nickel oxide was shipped at the end of that year.

Steps had been taken to convert the oxide into metal in an electric furnace but it developed that nickel oxide could be used as such at 2c a lb under the price of metal. Since it cost more than this to convert the oxide into metal, the electric furnace was abandoned.

In 1946 an effort was made to work out an arrangement with the Government for the lease of the plant and its operation on a commercial basis. Satisfactory terms could not be arranged, and at the beginning of 1947 the operation was terminated and the plant put into stand-by condition. When the Korean War started, the Government decided to reactivate this operation. At the Government's request, Freeport sent its engineers to Cuba. Their report recommended a rehabilitation program as well as a number of process improvements. This work has been done and the Nicaro plant has been producing nickel oxide since 1952.

Freeport has had nothing to do with the operation at Nicaro since submitting this report. Our interest in it has sometimes been confused because of the fact that Freeport's wholly owned subsidiary, Nicaro Nickel Co., gave its name to the town of Nicaro where the plant was built. Nicaro Nickel Co. owns extensive ore deposits in this area. Under a contract made many years ago, the Government pays Nicaro for this ore for the plant, but Nicaro Nickel Co. has no other connection with the operation.

Presently operating the Nicaro project for the Government is Nickel Processing Corp., 76% of whose stock is owned by National Lead Co. and the remainder by Cuban interests. The Government is now expanding this plant. By early 1957, the Government will have invested $90-million in these facilities at Nicaro, for which it is expected there will be coming to the U. S. about 50-million lb a year of nickel in the form of oxide.

It has been announced that after the addition to the plant has been completed efforts will be made by the U. S. Government to sell or lease this plant to private interests.

Moa Bay

In the intervening years, as a result of our study of nickel, Freeport had become convinced that there was a tremendous need for additional productive capacity and that the market was going to have a great growth. We wanted to be a part of the nickel business but we wanted to be in the business on a basis where our product would be so good and our costs so low that we could stand up in commercial competition against the established producers. We have examined properties in many parts of the world and have been constantly at work studying processes. It is our belief that we have our answer at Moa Bay utilizing a new process, part of which is the sulphuric acid process which we examined at the time of our first studies pertaining to the Nicaro orebodies, and a part of which is the Chemico process which has been utilized with such brilliant success by Sherritt Gordon at Fort Saskatchewan in Alberta.

At Moa Bay we made an interesting discovery. Although it first appeared that the orebody was similar to deposits near Nicaro, futher work showed that most of the nickel values were in the limonite. It further developed that the cobalt content of the limonite was much greater than that found in the Nicaro deposits.

What we have at Moa Bay is in excess of 50-million tons of ore averaging 1.35% nickel, 0.14% cobalt and 46.5% iron. If we want to include nickel-bearing ore containing slightly smaller percentages of nickel we can add considerably to our proven tonnage. In 1953 we had proven the orebody, satisfied ourselves that we wanted to tackle this project with the sulphuric acid-Chemico process, and had under way a pilot plant at Freeport capable of handling 10 tpd ore, with other facilities in New Jersey to handle the concentrates from this plant.

To get a commercial project started we needed funds. We asked the Government for two things: a certificate of necessity to let us write off 80% of the cost of the plant in five years—which was granted—and a purchase contract.

At that particular time considerable doubt was being expressed in many quarters about the success of the Chemico process. Sherritt Gordon had had successful pilot plant experience but was then in the process of building its commercial plant and its construction costs were substantially exceeding estimates.

National Lead was running into unexpected difficulties at Fredericktown and Howe Sound was having very widely advertised difficulties in Utah.

The Government was unwilling to commit part of its funds to a project that seemed so full of uncertainties. It proposed instead that the Government advance money for a 50-tpd pilot plant to test the process.

This was not requested by us and this counter proposal came as a disappointment. However it was not possible for us to raise funds for a commercial plant without a purchase contract for our output and the Government was the only party able to make such a contract.

An arrangement for the pilot plant and also for a purchase contract on a contingent basis was made. Our contract was signed in October 1954. A year was provided for its operation. of the 50-tpd pilot plant and another year was provided for its operation.

Operation of the pilot plant will undoubtedly result in certain savings but the plant will cost millions of dollars more because of rising construction and interest costs.

Under our plans, we would mine the ore from open pits; chemically beneficiate it by means of a sulphuric acid leaching process at Moa Bay; and ship the resulting concentrates to the U.S. for the final separation of the nickel and cobalt. The most important features are the recovery of a high purity nickel and cobalt separately as metals, not as oxides. Cobalt at the present time is selling at $2.60 a lb. With production of cobalt amounting to 10% of the amount of the nickel produced, this would help materially to reduce our costs in the same way that copper does for our competitors.

The Moa Bay project in my judgment is one of very great significance to the whole Free World. With the successful working out of a commercial project for the production of nickel from the Cuban lateritic ores there should never again be any doubt in the minds of customers that they will be able to get whatever nickel they need. Reserves in the island, as have been shown, are very large. As the demand grows, further deposits are available for development.

What Lies Ahead

It is my belief that with the great production from Inco, probably enhanced by new discoveries by that company; with the nickel coming to market from Falconbridge, New Caledonia and Sherritt Gordon; with 50-million lb a year from the Nicaro plant; and with the nickel from Moa Bay, people who are now designing away from nickel will design toward it. There will be active competition in the business.

There are still exciting prospects ahead as far as process is concerned. We shall, to begin with, be putting into the tailings dump, millions of tons of valuable iron ore. We shall be doing this because it will still be contaminated with chrome. The ores also contain appreciable amounts of zinc, copper, manganese and aluminum. Some day it is our ambition to ship from Moa Bay, iron and chrome and other metals in addition to the nickel and cobalt.

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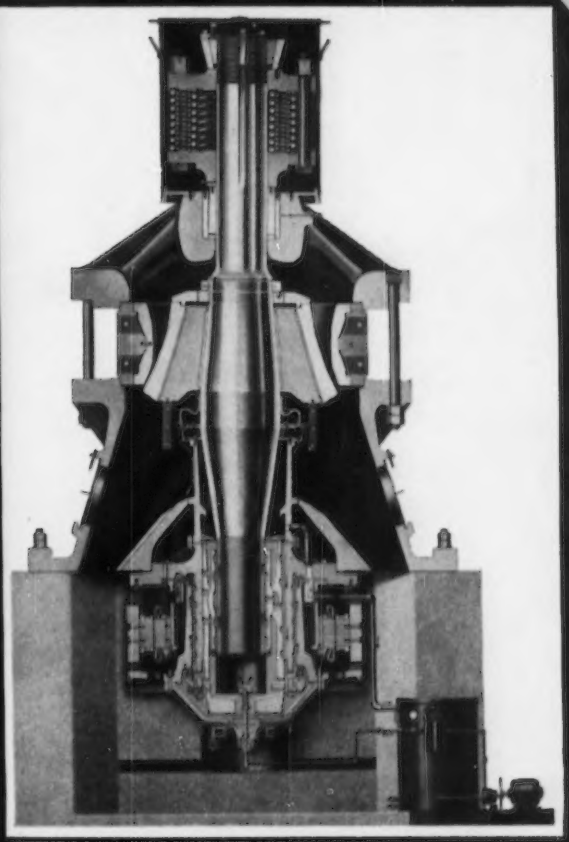

Cut-away drawing of KVS roller bearing, gearless Type "S" Crusher; low head type for fine crushing.

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THIS MONTH IN MINING (*Continued from p 73*)

From Arizona where the Tuba City resin-in-pulp mill boasts a 260 tpd capacity,

To Idaho where 175 tpd of mercury come from 4 Weiser area open pits . . .

Rare Metals Look to a Bright Future With New Growth Money

RARE METALS CORPORATION OF AMERICA probably is unique among mining companies in the United States.

First, it is a subsidiary of two natural gas firms—El Paso Natural Gas Co. and its affiliate Western Natural Gas Co.

Second, mainspring behind its formation, Ramco officers say, was the determination of El Paso president Paul Kayser, Houston, to reward faithful El Paso and Western employees with the opportunity to invest in a growth situation. He picked metals as a field which will profit greatly from advances in nuclear energy, electronics and automation.

Mitchell H. Kline, former chief of the rare and precious metals branch of the U. S. Bureau of Mines, was picked to spearhead the operations of the company. His background as a pioneer in the "war metals" (tungsten, uranium, manganese, et al) is invaluable to Ramco. And, as a former Bureau of Mines official, he knows how to make the most of exploration dollars.

Ramco has recently completed $7-million underwriting ($6,820,275 net to the firm). The offering was made at $5 a share to stockholders of the two gas firms, who insisted that they, as well as the employees, be given a chance to get a cut of the Ramco pie. It was oversubscribed by some 800,000 shares. The money's going towards the initial cost of two new Ramco projects: a new uranium mill at Tuba City, Ariz., serving the Cameron-Monument Valley-Marble Canyon district, and a mercury mine and reduction plant near Weiser, Idaho.

And an additional $2,663,746 is for exploration for uranium, tungsten, cobalt nickel, fluorspar, columbium, titanium, tantalum and similar metals. "It's not a big sum," says Mitch Kline, "but it's enough to permit us to broaden our interests."

Here's how the Ramco picture looks now:

- Uranium ore reserves of 270,765 tons running between 0.20 and 0.36% U_3O_8, and a resin-in-pulp processing facility with a 260-tpd capacity.
- Mercury reserves of 532,791 tons, with 5,000 tpm coming from four shallow open pits.
- Contracts with what Ramco terms a "major chemical company" have been signed which provide for the delivery of a minimum of 200 flasks of mercury a month—representing about 70% of the output from Almaden. To date the mercury has sold for an average of $260 per flask.
- Exploration programs in the Cameron area, Monument Valley, and the nickel-cobalt-chromium property at Pine Flat, Del Norte County, Calif.

And what's Ramco's goal?

According to Kline, to "grow just as fast as discovery will permit."

Lisbon Valley Mixup Ended *(Continued)*

Second largest equity holder becomes Hidden Splendor, a 100% Atlas affiliate.

Third largest equity holder becomes American Zinc, Lead & Smelting Co. headed by Howard I. Young, St. Louis, Mo.

The historic agreement, which was more than six months in negotiation, has two side effects:

1. It greatly stabilizes mining and milling operations in and around the Big Indian District. If Ute Milling had continued with its program, there would not have been sufficient ore to assure capacity operations of the URC mill. And the span of operations even at the La Sal project might have been somewhat shorter than engineers originally conceived.

2. It may free several smaller mill projects from an immediate knock-down drag out war for reserves. Continental Uranium Co., which had deferred construction of a 200-tpd mill near La Sal, would now be in position to continue, if it so decides.

Possible doubling of capacity of the Moab concentrator is under active discussion at this time. The decision rests upon another exhaustive analysis of ore reserves in the Big Indian District.

Richard A. Young, St. Louis, Mo., URC executive vice president, announced that the contract would assure URC's mill of capacity operations through the present Circular Five AEC ore-buying program ending March 31, 1962.

He said that the contract also assured production of uranium concentrates at Moab past that 1962 date and under the new concentrate purchase program of AEC.

Floyd B. Odlum, Atlas Corp., president, said that for his part the transaction: "Gives Atlas the benefit of firm contracts at satisfactory prices for the sale to the U. S. Government of the output of its mines.

"This definiteness as to price and quantity is in addition to the profit potentials connected with the milling operations, as such, and the benefits of higher depletion allowances that are foreseen as a result of concentration of the ore before sale."

The URC mill is scheduled to start operations between Sept. 15 and Oct. 1, Melich said.

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THIS MONTH IN MINING *(Continued)*

New Park Mining Closes; Victim of New "Squeeze"

NEW PARK MINING CO., which started operations in 1932 at the Park City District, has suspended work.

W. H. H. Cranmer, company president said the shut-down of the lead-silver-zinc producer was for an "indefinite period."

This is the first suspension of work in the history of the company, despite onerous economic conditions in the past 24 years which caused failures, mergers and other problems to companies in the district.

Only the United Park City Mines Co. remains as a principal producer at this time in the historic Utah mining district which geologists say still contains hundreds of millions of dollars in unmined metal values.

The close down came at a point when the mining company was in a position to explore newly discovered bedded ores as well as an increase in copper values found in the original fissure system.

New Park in last 12 months also had launched an aggressive mine development program on four levels with aim of hiking production.

It also had proposed a $500,000 exploration and development program to Defense Minerals Exploration Administration. Cranmer said this application still was being pursued and that New Park had the necessary $250,000 in cash to meet its portion of the commitment.

"But at present," he said, "we have been losing money every month so far this year. There's no use frittering away any more of the company's financial reserves and going into debt."

Cranmer blamed the following economic conditions facing the Western mining industry on suspension of mining by his firm:

"Massive and growing imports of lead and zinc produced by low-wage foreign mines, many of which have been subsidized by outright grants from our own country.

"The inflationary spiral of cost of mine supplies, in which situation domestic producers have been caught in a squeeze, as there have been no comparable rises in metals quotations.

"The declining productivity of mine labor attended by increased wage costs.

"The higher freight rates which only this year went up 21%."

He said that under the impact of economic conditions few underground mines in Utah had been able to conduct the vital exploration and development work during and after World War II which would have assured adequate and immediately available ore reserves for continuous volume production.

"It's as simple as ABC, as I told the miners," Cranmer related. "Without exploration, there is no discovery. Without discovery, there is no mine development. Without mine development, there is no production. Without production, there is no profit. Without profit, there is no mining company and without a company, there's no job."

Matt Leahy, Park City, Utah, president of Local 4264 of United Steelworkers of America, CIO, said:

"We know that New Park is one of the best companies in any mining district in the West.

"We in the union want to help out any way we can. We know that Harry Cranmer has made an effort to keep the mine in operation when other mines throughout the country have been forced to close down." (See p 73.)

BLM Needs Engineers

MINING VALUATION ENGINEERS are needed by the U. S. Dept. of Interior's Bureau of Land Management and other Government agencies. Jobs are in the far West and Alaska, pay from $4,480 to $7,570 a year.

Post Offices and the Civil Service Commission in Washington have further information. The Civil Service examiners in Portland, Ore., are accepting applications at 1001 N. E. Lloyd Blvd.

Rutile Deposits Opened In Sierra Leone

WHAT MAY BE A VAST but low-grade rutile-ilmenite deposit, has been reported in Sierra Leone in the stream gravels of the Scarcies River, just below the confluence with Mabole River near Port Loko. Under an expedition led by Dr. J. R. F. Joyce, geologist, three separate types of titanium-bearing deposits were uncovered: small elluvial rich deposit containing several thousand tons rutile; a small, rich alluvial deposit of the same general size; and a large, low-grade deposit of rutile and ilmenite in clay and sand from an ancient marine sediment. This last mentioned may hold several million tons rutile and ilmenite.

Straight beach sand mining and milling can handle the first two types, but the clayey nature of the marine sediments so far has resisted laboratory development. A pilot plant will be set-up under Joyce and should a method be worked out, a company will be formed—British Titan Products—to develop the deposit of marine sediments. Columbia Southern Chemical Corp., U. S., will share in the development program with British Titan.

Cerro de Pasco Opening New Mining District

FOLLOWING FIVE YEARS of exploration, Cerro de Pasco Corp. is taking preliminary steps toward the development of Antamina copper deposit in Huari Province, Ancash Department, Peru. Total estimated reserves now exceed 70-million tons, 1% Cu.

Plans call for constructing a heavy-duty highway approx 200 km long from Antamina to Cerro's railroad siding near Cerro de Pasco. This will permit truck and rail haulage of concentrates from the future mine to La Oroya smelter and in addition will open up a new mining and agricultural district by providing access way to the south.

First section, to be completed this year, is from Antamina to Intipunco, a distance of 47 km. Presently, Intipunco can be reached from Cerro only by a long roundabout haul through Huanuco (see map). Second section from here to Cerro's siding, 153 km away, may be started after the rainy season ends next year.

Antamina was explored during 1951 to 1953 at a cost of $150,000. Based on study of some 3500 samples and geological data, the company now intends to get more conclusive data before determining whether or not to develop the property. While tentative decisions have been made, no final production plans can be stated until Cerro learns more about the deposit.

Decision by Cerro de Pasco Corp. to proceed with the road to Antamina is a further indication of the beneficial effects of the 1950 Mining Code of Peru, which is attracting large-scale foreign investment and strengthening Peru's economy. Article 240 of the Mining Code permits the government to rebate, in the form of export taxes, all money advanced by a commercial firm in the construction of a new highway. Purpose of this article is to permit the mining company to open both a new property and the surrounding territory. When completed, this highway will connect the Antamina deposit and surrounding territory with Cerro, La Oroya and Lima.

"Sunday-Punch"

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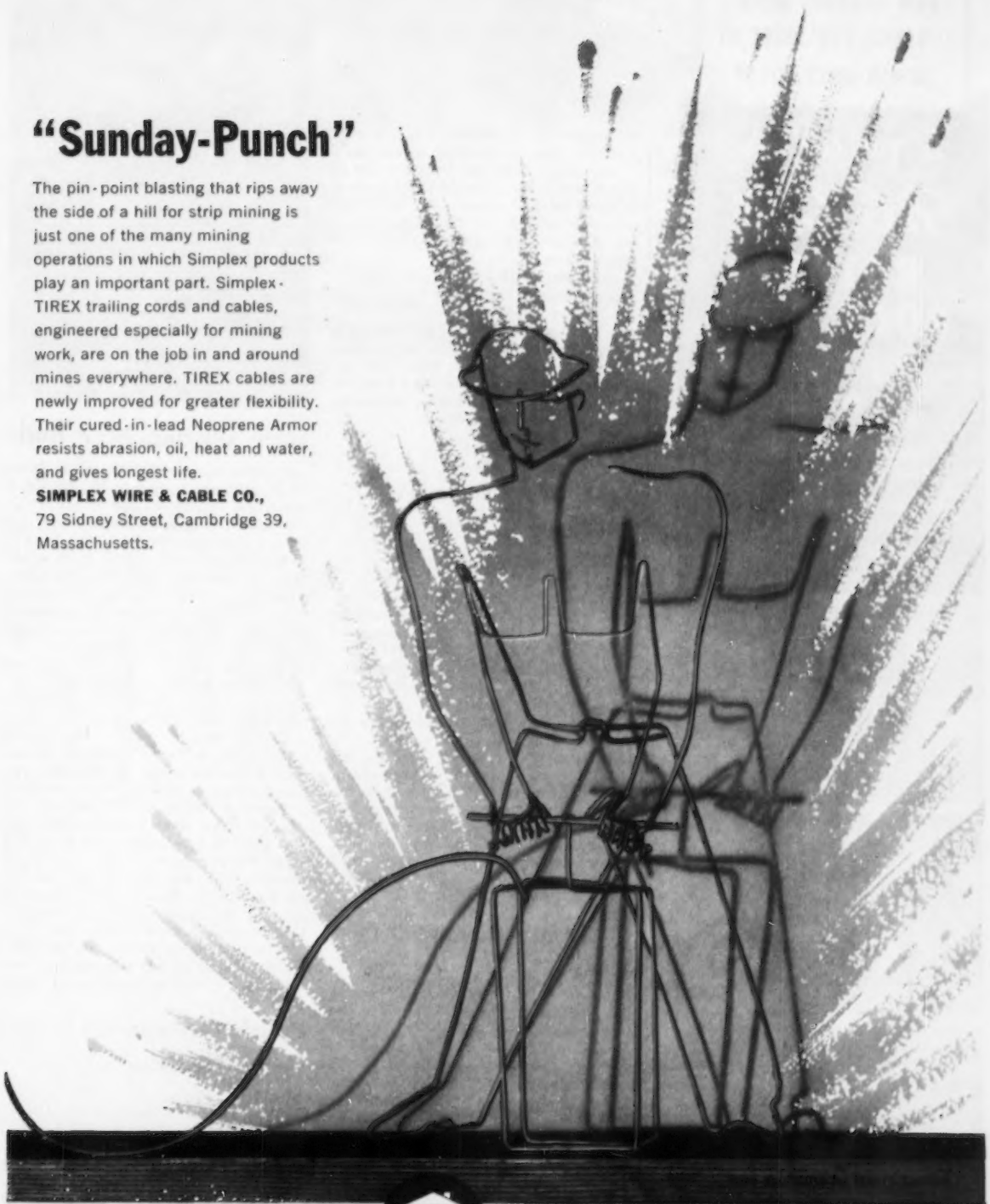

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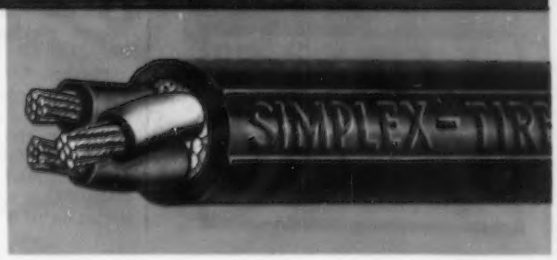

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Rum Jungle Acid Made on the Spot

WORK ON A NEW ACID PLANT at Rum Jungle, in the Northern Territory of Australia has been begun by Simon-Carves Proprietary, the Australian subsidiary of Simon Carves Ltd., English manufacturers of chemical equipment.

The plant, built for Territory Enterprises, will allow a considerable increase in the refining of uranium ore. It will use imported sulphur for the production of the sulphuric acid needed to refine the precious ore.

According to H. J. W. Morrison, managing director of Simon-Carves (Australia), the plant, which will be the biggest on a mining field in Australia, will more than treble the present acid-making capacity of Rum Jungle. Machinery for the plant has been shipped from England, and structural steel and other equipment has been sent from Sydney.

Rolla Symposium To Study Basic Mining Research

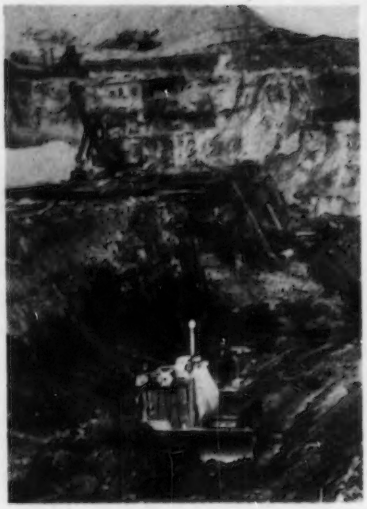
FUNDAMENTAL AND DEVELOPMENTAL RESEARCH will be spotlighted at the second anuual Symposium on Mining Research sponsored by the U. S. Bureau of Mines and the Missouri School of Mines and Metallurgy. The meeting at Rolla will take place Nov. 12 and 13.

Among the topics covered in the addresses by experts from industry, universities, and the Bureau are blasting, rotary and percussive drilling and tunnel mining in hard rock. The story of the development of cemented tungsten-carbide tipped Swedish drill steels will be traced, and a special focus placed on the most recent trends in the tri-state district.

New Ambrosia Lake U_3O_8 Find

PHILLIPS PETROLEUM CO.'s exploration has discovered a new 1.5-million ton high-grade uranium orebody in New Mexico in the heart of a district said to contain three-quarters of known U. S. uranium reserves, K. S. Adams, chairman, and Paul Endacott, president, have announced. Discovery resulted from intensive core drilling on a 1,280-acre mining lease in Ambrosia Lake area near Grants, N. M. Company is acquiring full working interest in the lease by purchasing the remaining one-quarter interest previously held by Holly Minerals, Inc.

Further drilling by Phillips continues on the unexplored portions of the lease. Engineering studies of the orebody are underway and a mining shaft will be started this fall. The company has initiated negotiations with the Atomic Energy Commission for the erection and operation of a mill to process the ore.



Deep Digging Near Butte

AN OPEN PIT OPERATION near Butte, Mont., will mean digging 200 to 600 ft below the present surface to extract an estimated 100-million tons of copper ore for the Anaconda Co.

A contract let on a joint basis to the F&S Contracting Co. and Morrison-Knudsen Co. calls for the removal of millions of tons of overburden and copper ore. Removal of the ore has already begun, and when the removal hits top speed—planned for late 1957—ore will be mined at the rate of 17,500 tpd.

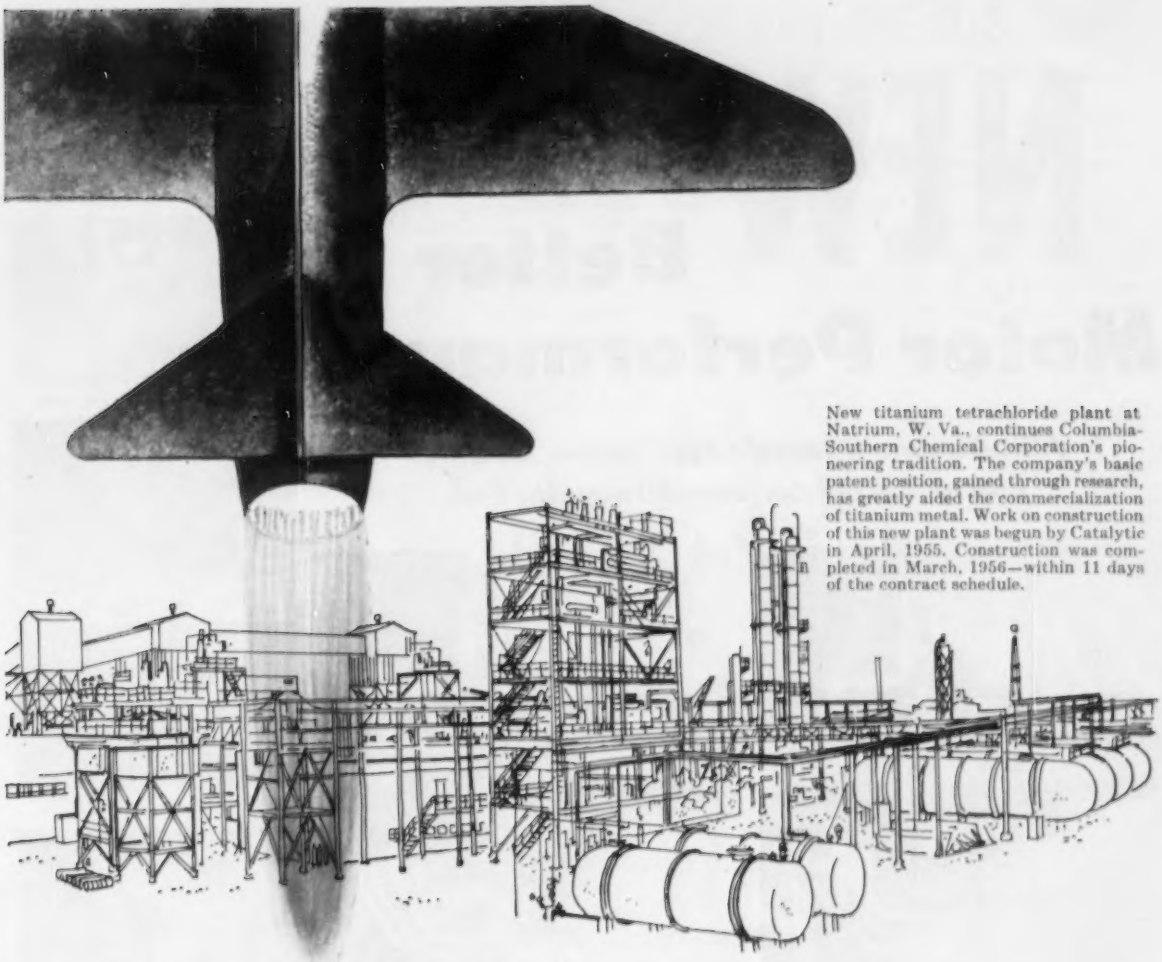
Exact location is the Berkeley Pit, which was first discovered in exploratory cross-cuts from the Kelley Mine (where block caving is done). It consists of secondary enriched copper ore. The Berkeley Pit covers an area of 2400 ft by 4200 ft.

Shown is one of three Caterpillar D8 tractors which level waste material and also maintain haul roads in the Butte Hill area. Hauling units include 18 Mack trucks and 22 Euclids. Also on the job are four Bucyrus-Erie shovels performing stripping operations, and two Caterpillar D6 tractors to work under the 150-B shovels cleaning up spilled material. Drilling rigs consist of one Bucyrus-Erie drill and two Joy truck-mounted rotary drills.

Polish Government Permits Release of Mining Data

FOR THE FIRST TIME, Poland has announced its mine output data in quantity units instead of merely as percentages of past production or planned goals. Production figures for the first six months of this year were as follows:

	Metric tons	Percent of production for 1st ½ of '55
Iron ore	779,000	103
Lead-zinc ores	1,130,000	96
Copper ores	605,000	126
Aluminum	11,000	111
Zinc	77,000	102



New titanium tetrachloride plant at Natrium, W. Va., continues Columbia-Southern Chemical Corporation's pioneering tradition. The company's basic patent position, gained through research, has greatly aided the commercialization of titanium metal. Work on construction of this new plant was begun by Catalytic in April, 1955. Construction was completed in March, 1956—within 11 days of the contract schedule.

$TiCl_4$
(Titanium tetrachloride)

A new multi-million dollar plant at Natrium, W. Va., is the answer of *Columbia-Southern Chemical Corporation* to the task of producing $TiCl_4$—titanium tetrachloride—which in turn is used in production of titanium.

Titanium is metallurgy's answer to the need for metal resistant to high temperatures—as in supersonic aircraft.

Titanium tetrachloride—the product of this new plant engineered and constructed by Catalytic—has opened up important markets in diversified other fields as well as in production of titanium sponge. Its many uses include the manufacture of catalysts for plastics, the making of titanium esters, and service as a reducing agent for dyes.

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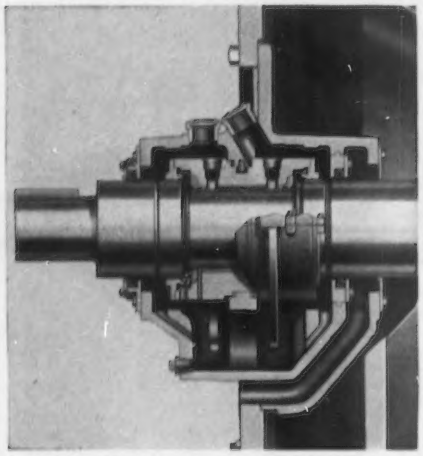
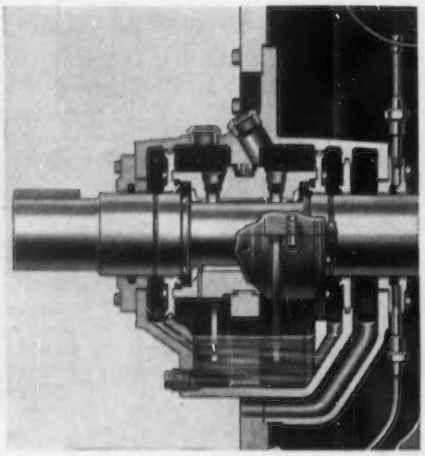
NEW Bearing Design Means Better Motor Performance

Allis-Chalmers capsule-type sleeve bearings now perfected for complete motor line



Standard capsule-type sleeve bearing



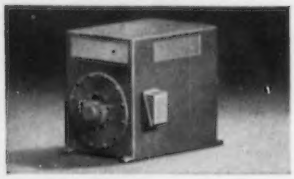
High speed capsule-type sleeve bearing

A new feature—an improved capsule-type bearing design—has been added to the Allis-Chalmers complete line of large end-shield bearing motors. This new bearing will give you better motor service, simplified maintenance and longer motor life through features like:

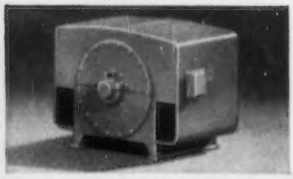
- Dust-tight, leakproof enclosure protects bearing from dirt, dust or abrasive materials.
- Venting system prevents oil leakage — keeps oil and vapor from getting into motor enclosure.
- Dual oil-rings insure bearing surface lubrication — either ring can adequately lubricate bearing.
- Split end-shield gives easy accessibility to winding and air gap — without disturbing capsule or bearing alignment.

Drip-proof or splash-proof cage motor

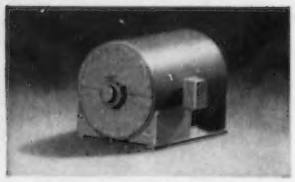
Synchronous or wound-rotor motor



High speed cage motor

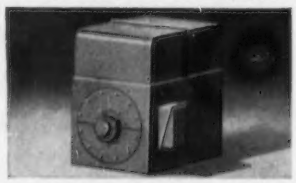


Weather-protected motor



Totally-enclosed fan-cooled motor

Totally-enclosed forced-ventilated motor



Water-cooled or inert-gas-filled motor

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Mining Calendar

Sixth annual Drilling Symposium, University of Minnesota. Minneapolis, Oct. 11-13

28th annual meeting, Society of Exploration Geophysicists, San Antonio, Tex., Oct. 13-16

44th National Safety Congress. Chicago, Ill., Oct. 22-26

AIME-ASME Joint Solid Fuels Conference, Sheraton Park Hotel, Washington, D. C., Oct. 25-26

Engineers' Council for Professional Development, 24th annual meeting, Detroit, Oct. 25-26.

Energy Resources Conference, Denver Chamber of Commerce. Cosmopolitan Hotel, Oct. 29-31

New Mexico Mining Assn. and International Mining Assn. Carlsbad, N. M., Nov. 1-3

Northeastern Branch conference, AIME. Hershey, Pa., Nov. 8-10

American Society for Metals, second world metallurgical conference. Cleveland, Ohio, November

Mining-Chemical Inter-Industry Conference, sponsored by San Francisco Chamber of Commerce. Fairmount Hotel, Nov. 9

Symposium on Mining Research, Missouri School of Mines & Metallurgy. Rolla. Nov. 12-13

North Central Region, National Assn. of Corrosion Engineers, convention and technical seminar. Detroit, Nov. 15-16

National Chemical Exposition, ninth annual show. Cleveland Public Hall, Nov. 27-30

Assn. for Applied Solar Energy, symposium on solar furnaces. Phoenix, Jan. 21-22, 1957

Plant Maintenance & Engineering Show, conference held concurrently, Cleveland Public Auditorium, Jan. 29-31, 1957

California Governor's Industrial Safety Conference. Biltmore Hotel, L.A., Feb. 7-8, 1957

National Western Mining Conference, sponsored by Colorado Mining Assn. Denver, Feb. 7-9, 1957

Annual meeting, AIME, Hotels Roosevelt and Jung, New Orleans, La. Feb. 24-28, 1957

Nuclear Conference, NICB, AIChE, other societies. Philadelphia Convention Hall, March 11-15, 1957

Pacific Southwest Mineral Industrial Conference, AIME, Reno, April 5-6, 1957

India's Metal Production Up

INDIA'S 1955 MINING OUTPUT WAS UP over the previous year according to official report. Increases in the dollar value of copper ore, limestone, chromite, gypsum and ilmenite were shown, while iron ore took a 10% jump to 4.6-million tons. Mica and manganese recovered from slumps to finish over the 1954 mark.

The major decreases were in the precious metals. Gold production hit only 210,880 oz—better than 28,000 off—and silver dropped 10% to 15,425 oz.

Fansteel Spends $6.5-million For New Cb-Ta Plant

FANSTEEL METALLURGICAL CORP. recently announced plans to build a $6.5-million plant for production of columbium and tantalum at Muskogee, Okla. Construction will begin in October.

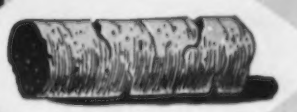
The new plant will increase Fansteel's tantalum capacity by 50% and its columbium capacity by 150%. The site includes 113 acres on the Arkansas River.

IN THE U. S.

ALASKA

Successful metallurgical tests on copper ores from four Alaskan deposits were reported during August by the Bureau of Mines in Washington, D. C. A report released by Interior Secretary Fred Seaton said tests indicated the ores could be treated by standard methods to produce commercial grade copper concentrates. The report described preliminary laboratory studies of samples from the

MORE CORE



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ADJUSTABLE INNER TUBE: To regulate the force of the fluid at the mouth of the bit and to reduce the interval in which the core is subject to wash by the circulating fluid.

FLUID LUBRICATED BEARINGS: No grease packing every time you cut a core—the bearing is lubricated by the water or mud circulated.

STABILIZED INNER TUBE: No core lost because of friction grinding.

SKIRT TYPE CORE SPRING: Tilting or cocking of core spring is eliminated. No core loss due to grinding, blocking or core wash.

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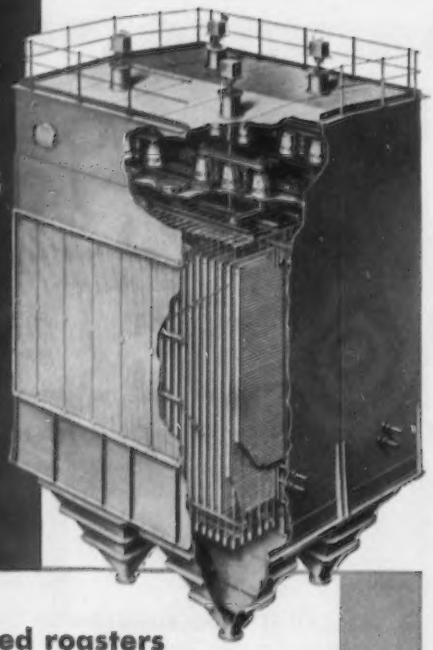

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Alaska *(Continued)*

Moth Bay mine, Revillagigedo island, south of Ketchikan; Three-Man mine, Port Fidalgo area; Gold Zone mine, near Colorado station and the Kathleen-Margaret prospect on the McLaren River near Paxton.

R. R. Wells, supervising metallurgist at the bureau's Juneau station where the tests were made, said copper recoveries, using standard flotation techniques, ranged from 79% for the Moth Bay ore to more than 95% for the Kathleen-Margaret sample. The highest grade concentrate, assaying 36.7 copper, was obtained from the Kathleen-Margaret sample.

A single piece of jade estimated to weigh at least 2,000 lb has been successfully hauled out of the Jade Mountain area to Kotzebue in northwest Alaska and is presently awaiting shipment to the Orient. Owner-operator of the mine from which the stone was taken, Gene Joiner, intends to sell the stone in one piece, probably for a monument. Last year Joiner toured the Orient jade centers seeking a market for it.

Curtailment of placer operations by the territory's largest mining concern, (United States Smelting, Refining & Mining Co.) during 1957 has been predicted by the Alaska Territorial Employment service.

It is only a matter of time until costs make continuation of the placer operations prohibitive unless the price of gold is increased or mining costs can be cut down, James C. Crawford, president of the company, told the Fairbanks Chamber of Commerce recently.

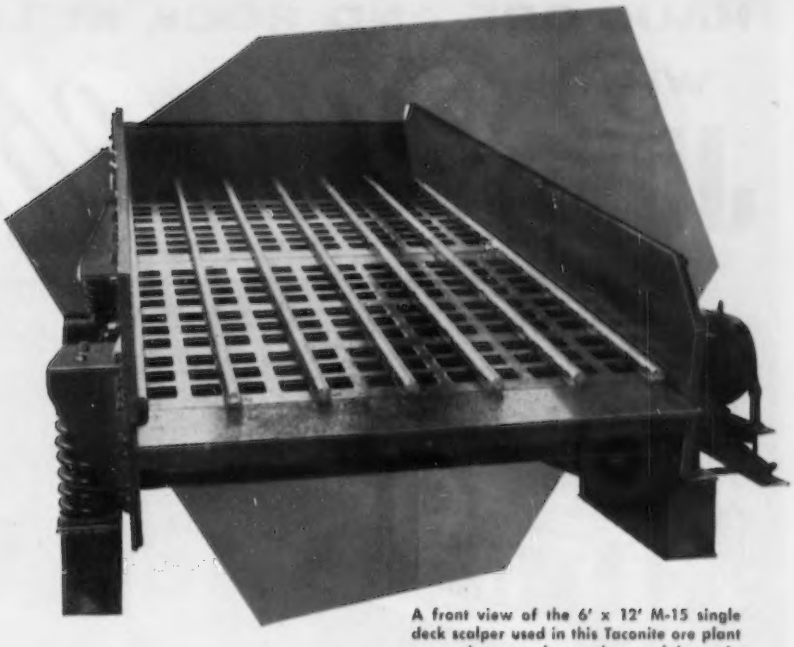
National Silver-Lead Mining Co.'s gold-dredging venture along the Niukluk River on the Seward peninsula of Alaska has been in production since July 21 at the rate of about 1,400 cu yd of gravel per day and company officials are hopeful that this can be boosted to dredge capacity of 2,000 yd per day after ground-thawing difficulties have been overcome. Operating profits at the current rate are approximately $260 per day, which should mean a net profit of between $10,000 and $15,000 for this year's operating season, according to company officials. Capacity production would boost the daily profits to $500, they said.

The Wallace firm is purchasing a 49% interest in the operation from Northern Mining Co., also of Wallace, which controls more than 12-million cu yd of virgin gold-bearing gravel along the Niukluk River.

ARIZONA

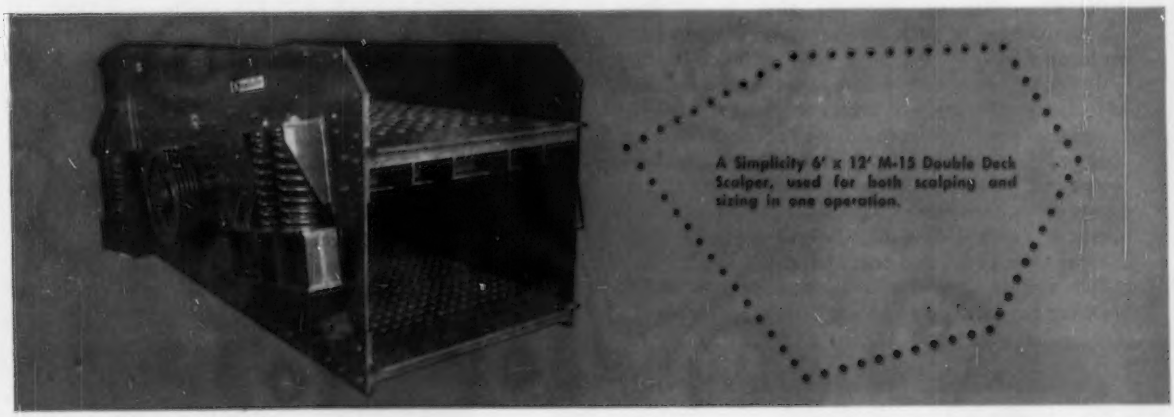
Dasco Mines Corp. will build a 100-ton manganese flotation mill at Wenden to concentrate ores to above the 40% grade —the grade that now is acceptable by the Government in carlot shipments to its depot at Deming, N. M.

430 long tons per hour of Taconite ore handled by this SIMPLICITY scalper



A front view of the 6' x 12' M-15 single deck scalper used in this Taconite ore plant as a primary and secondary scalping unit.

Lumps up to 24" of hard, tough, extremely abrasive Taconite ore are scalped by this Simplicity 6' x 12' Model M-15, at a throughput rate of 430 long tons an hour. This primary scalper is accompanied on the job by six other heavy duty Simplicity units, all of them, of course, handling the same gruelling fast flow of Taconite. First operation in the Taconite processing is feeding the ore to the primary scalper: this is done by a Simplicity 6' x 16' Model MA Feeder. Large chunks are fed off the 6' x 12' single deck M-15 primary scalper onto a Simplicity 6' x 20' Picking Table, where all obvious shale, stone, and other foreign material is removed. From here, the ore is put through a jaw crusher, and from the crusher two Simplicity 5' x 20' Feeders set in tandem deliver it to the secondary scalper. This unit, like the primary, is a Simplicity M-15 6' x 12' Heavy Duty Scalper. Fines from this operation now go to a Simplicity Double Deck 6' x 12' M-15 Scalper, where they are both scalped again and graded. Larger lumps are fed through a cone crusher, then they are likewise scalped and graded. The ore is now ready for extraction. This whole plant is set to work 24 hours a day seven days a week . . . and the rugged Simplicity equipment assures that down time will be negligible. Write today for details of Simplicity units for your own operation.



A Simplicity 6' x 12' M-15 Double Deck Scalper, used for both scalping and sizing in one operation.

186

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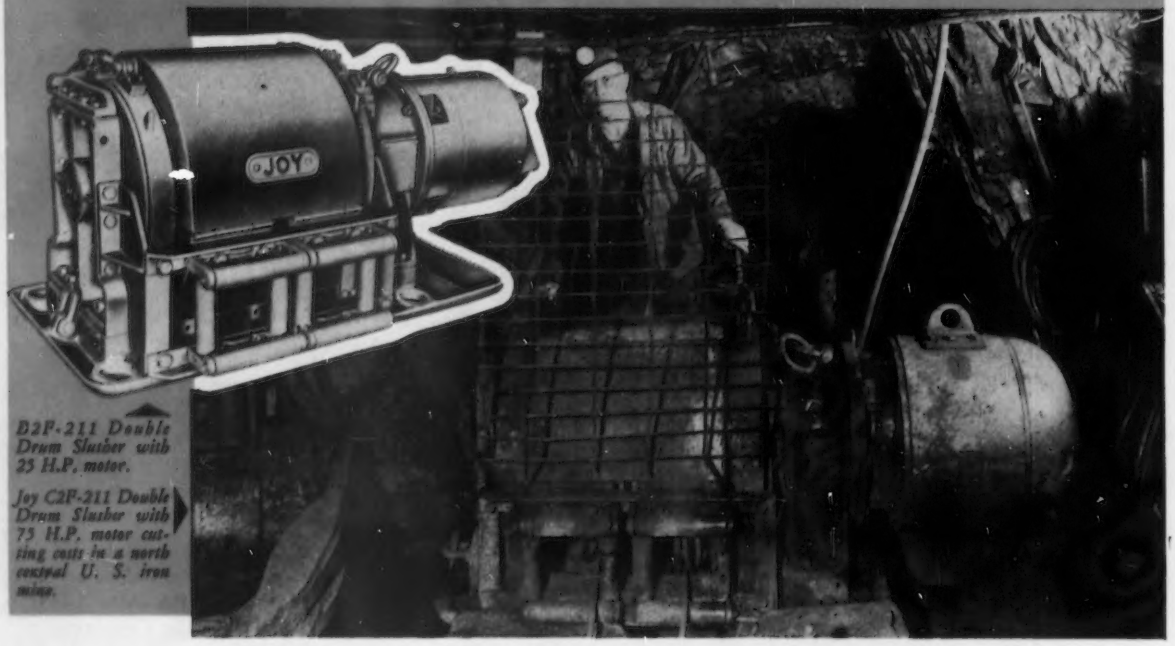

B2F-211 Double Drum Slusher with 25 H.P. motor.

Joy C2F-211 Double Drum Slusher with 75 H.P. motor cutting costs in a north central U. S. iron mine.

The A-B-C's of low cost scraping are not learned in school—you learn them in the field. Joy A-B-C slushers, A2F, B2F, and C2F, two and three drum, have demonstrated, in mine after mine, their ability to haul at rock bottom cost. It's not hard to learn why.

Joy A-B-C slushers operate at lower cost because clutches are bigger and wider for longer life—for longer intervals between adjustment and relining. Rugged construction with one-piece rigid base keeps all working parts in perfect alignment. Large drum diameters give longer rope life. A-B-C slushers reduce operator fatigue because their clutches are 100% self-energizing.

For simple, low-cost maintenance Joy A-B-C slushers have only one grease fitting per drum . . . to service each drum's planetary gear train. Grease reservoirs adjacent to shielded type ball bearings provide lubrication as needed. Clutch bands and adjusting nuts are out in the open, easily accessible for adjustment and relining.

These are just some of the cost saving features built into the Joy A-B-C line. They are available with flange mounted electric or air motors from 10 to 75 H.P.

Why not find out more about the A-B-C's? Write to Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa. In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

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JOY

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Arizona *(Continued)*

Harrison Doyle, Vista, Calif., Dasco president, said the mill primarily is for the company's ores, but would handle some custom milling. Dasco operates several groups of mines in Arizona and delivered more than $1.5-million in manganese ores to the Government's Wenden stockpiling depot during the period truck shipments of low grade were acceptable.

The Wenden depot was closed after some $15-million in manganese was stockpiled.

CALIFORNIA

Fairmont Minerals, Inc., Los Angeles, plans to build an ore processing plant at Four Corners, San Bernardino County, 7 miles east of Boron.

Fairmont leased a 160-acre mill site from Dr. James Gillis, Beverly Hills, and moved in a rig to drill a water well on the property. The lease contained an option to buy the property.

Total investment in plant and property will be about $100,000, according to a company spokesman. The mill will employ 20 persons when in full production.

Officers of Fairmont Minerals, Inc., are L. A. Thomson, Pasadena, president; Allan F. Zalk, Los Angeles, vice president; Herbert H. Schisler, Los Angeles, secretary; and James Coson, Los Angeles, treasurer.

A change in ownership of Surcease Mining Co. is foreseen following a recent meeting of company stockholders. Stockholders decided to sell their interest in the company, whose prime holding is scheelite deposits in the Atolia, San Bernardino County, area.

Decision to sell is believed to be influenced by recently-enacted legislation extending the Government's strategic minerals purchasing program. Extension of the buying program extends life of the Atolia operations, stockholders feel, making for new interest to prospective buyers.

The decision to sell will not necessarily affect continuity of operations on company property at Atolia, according to a company spokesman. At present Surcease Mining Co. leases claims to miners on a program under which miners dig the ore, the company mills and sells it, and gross proceeds are divided equally.

Resumption of gold mining operations is planned at the Black Hawk mine near Randsburg, Kern County. Bel Air Mining Co. has overhauled the mill at the mine and is getting the mine in shape for new operation. Bel Air plans to mill its gold at the mine site. Partners in the company are Howard Le Grant, Claude Le Grant and Dan Prlia.

Charles Roberts & Associates, Santa Ana, have reopened the Zenda gold mine in Studhorse Canyon near Caliente, Kern County. Roberts & Associates hope to turn the once-famous mine into a

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California *(Continued)*

uranium producer. A number of years ago the Zenda mill used to process more than 250 tpd ore from the mine.

COLORADO

Several claims of rare earth properties in the neighborhood of Buena Vista have been acquired by the Natural Power Corp. of America. Howard Williams, president of Western Bond & Share, Tulsa underwriters, announced. Williams said rare earths such as lanthanum, cerium, europium and samarium are becoming increasingly vital to modern industry, and that the per-gram price of such earths runs as high as $300. Williams also said the development would round out the three-part expansion plans of Natural Power.

[**Ed. Note**—While some rare earths may sell as high as $275 per g, only minor amounts are sold annually.]

With the discovery of high-grade ore on the 3,000-ft level of the Ajax and good ore in other company operations, the future at the Golden Cycle property looks brighter than it has in several years. Driving into the New Market granite fault on 3,000 the company found ore that grabs 2 to 4 oz gold to the ton. There is 270 ft of virgin ground above them. A recent shipment of screenings settled at 3.47 oz gold.

First shipment of ore from Minnie Mine on Mineral Hill near Breckenridge consisted of 77 tons with high silver content. Operations are temporarily suspended while the diesel power equipment is overhauled, but shipments will be continued. Minnie Mine was taken over last year by Dave Davenport of Breckenridge, who has kept a crew there during the winter and spring cleaning out cave-ins and re-timbering the property.

The Golden Cycle Corp. case to recover damages amounting to about $2-million as the result of the Federal Government closing down gold mines in 1942 appeared brighter as a result of action in Washington recently. The U. S. Court of Claims has reaffirmed a previous decision that six gold mining companies are entitled to recover damages for closing of their mines by Government order during World War II. Thomas M. Burgess, legal counsel for Golden Cycle, expressed the opinion that it might be months before any decision is made. "And chances are good the Government will appeal the cases to the Supreme Court," he said.

Ed Kolbach and Mark DeAngelo, owners of the K & D Mining Co. of Florence, are reported to have made a deal to operate under lease the Nellie Bly gold property, four miles southeast of Buena Vista, Chaffee County, and plan to start work within a month's time. They propose to install a small milling plant to recover free gold from ore now available and to do much work to develop more ore. A. S. Calloway is owner of the Nellie Bly.

Universal Mining Consultants of Grand Junction has completed a grid survey of the Betty group of claims, northeast of Gunnison. Property is held by J. M. Buffington, Art Fordham and the Neese Exploration Co. Neese, a Texas firm, will do the preliminary drilling with deeper exploration at a later date.

C. A. Burke and others of Fort Worth, Tex., have acquired a number of mining claims in South Park and North Chaffee Counties. The company has done some core drilling as well as drag line and dozer work, and plans to core drill several thousand more feet. Mr. Burke and associates have been working in this area for the past year and say they have uncovered several deposits of uranium as well as a number rare earths with some assays running as high as 5% yttrium.

In 1955, Colorado produced minerals exceeding production of the previous year, according to the annual report of the Colorado Bureau of Mines for the year 1955, submitted by Commissioner of Mines, Walter E. Scott Jr. Total value of metallic and non-metallic minerals, petroleum, sand and gravel produced in the state for 1955 was $381,709,013.

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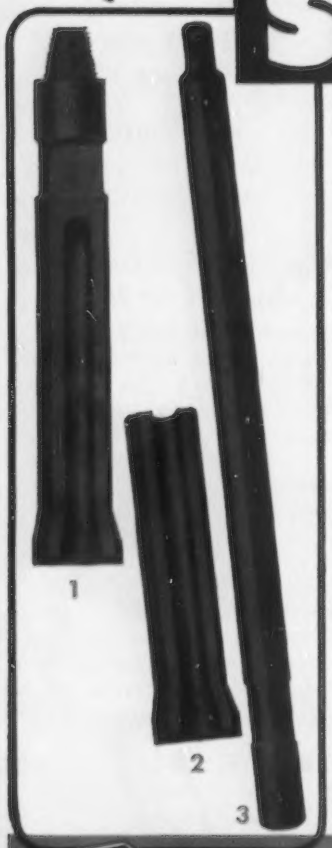

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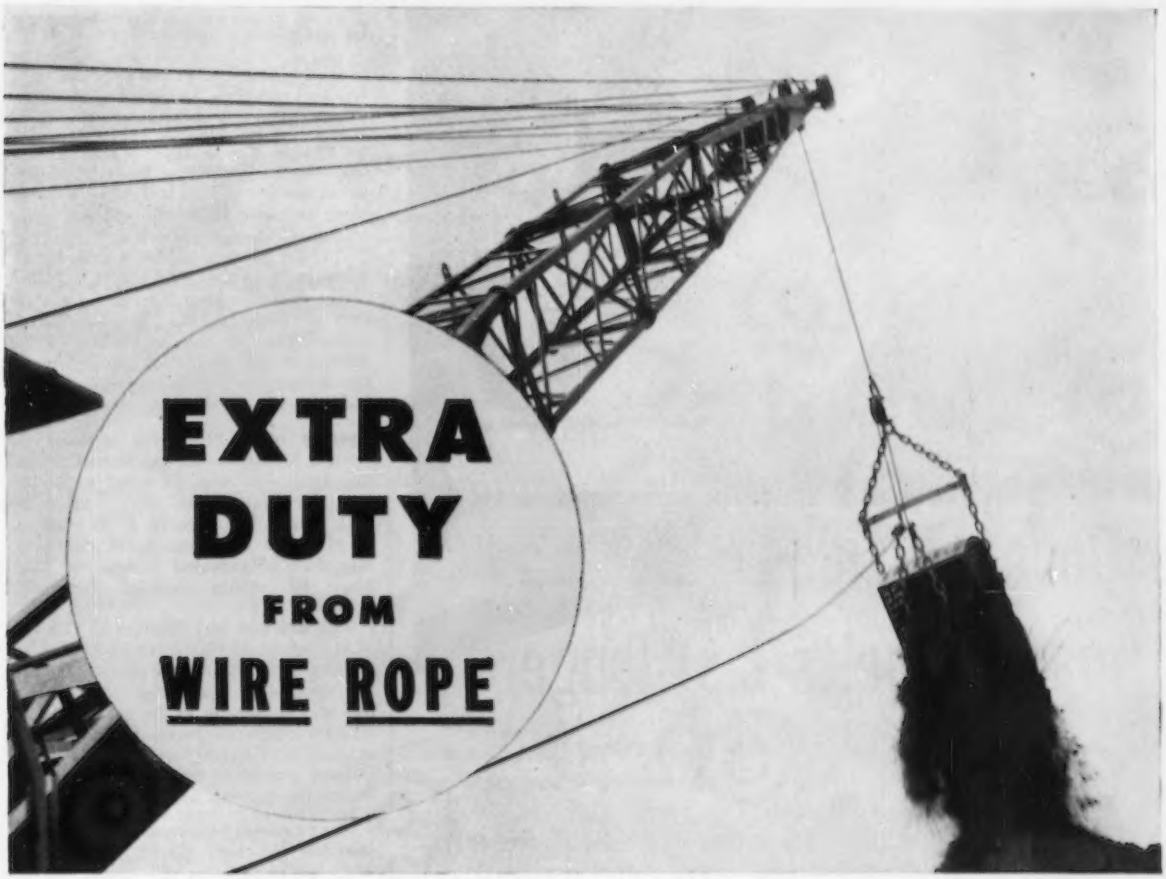

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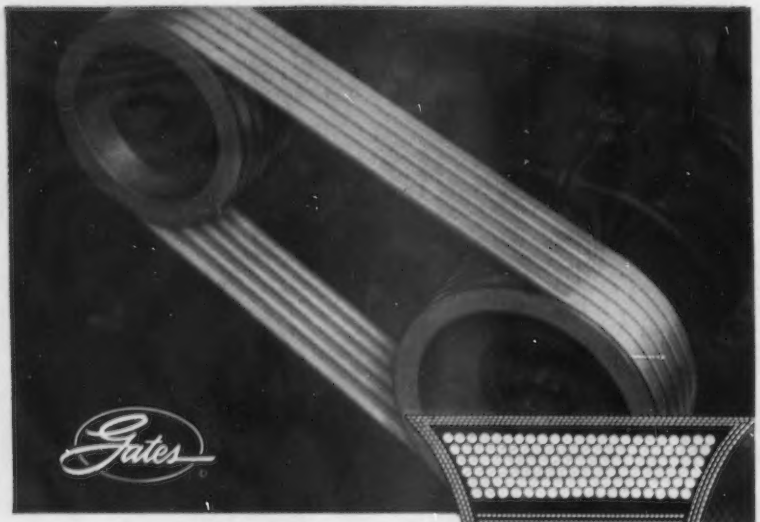
American Logging Tool Corporation is a subsidiary of Broderick & Bascom Rope Co.



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The sides of every Gates V-belt (Fig. 1) are concave—a precisely engineered curve that greatly increases V-belt life. Here's why:

On the bend around the sheave, the concave sides of a Gates V-belt fill out and become straight (Fig. 1-A). Thus the belt makes full contact with the sides of the sheave, grips the sheave evenly, and wear is distributed evenly across the sides of the belt. Uniform wear lengthens belt life; keeps costs down.

Make this simple test

Take a straight-sided belt (Fig. 2) and bend it. Feel the sides at the bend; they bulge out. Now picture this bulge in the sheave groove (Fig. 2-A). It is easy to see that the belt makes uneven contact at points indicated by arrows. Naturally, wear is greater at these points. Uneven wear shortens belt life; increases belt costs.

Cut down-time and V-belt replacement costs. Specify belts that grip evenly and wear longer . . . specify Gates Vulco Rope—the V-belt with concave sides. There is a Gates distributor nearby who will quickly supply the belts you need. The Gates Rubber Co., Denver, Colorado
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TPA 86

Gates VULCO ROPE Drives

Colorado *(Continued)*

It exceeded the 1954 record by $44,495,562 and established a new all-time high record for mineral production.

At Cripple Creek, Front Range Mines, Inc., is leasing from 2,600 ft depth to surface on Golden Cycle property along the west side of the Strong mine boundary. The company is in high-value ore with shipments settling from 2 to 4 oz gold per ton. Front Range, owner of the valuable Strong property, has in turn given the Ajax a lease on Strong ground. The two companies plan a joint venture driving at 3100-ft depth through the Strong to the Independence. The Independence is U.G.M. property.

Opening of 21,713 acres of land in western Montrose and San Miguel Counties to staking Aug. 31 failed to create a major claim rush that had been anticipated. The County Clerk's office at Montrose had hired extra clerks to take care of expected filings, but only about 60 persons recorded claims on opening day.

The situation was different at Grants, N.M., where 12,000 acres in McKinley County were opened to prospectors on the same day. There one organization moved 250 men on to the newly-opened area in chartered buses, began staking at sight of a signal flare at 10 am, and claimed ground in five different sections before the day was over.

Utaco Uranium, Inc., announced outright purchase of two closed corporations with headquarters at St. Louis, Mo.—Motah Uranium Co. and Utah Southern Exploration Co. The transactions give Utaco title to 34 claims in the Blind River area of Canada, 377 claims in the vicinity of Green River and Hite, Utah; and equipment valued at $75,000.

GEORGIA

Port Wentworth Corp. will make a $150,000 preliminary mining survey on nearly 2,000 acres of potash land it recently leased near Port Wentworth, Ga.

IDAHO

New incline shaft which Nabob Silver-Lead Co. is sinking on the D-5 vein at its property in the Pine Creek section of the Coeur d'Alene District has been in good ore all the way to the 100-ft point and is progressing at the rate of about 4½ fpd. Plans are to go to the 200-ft level and possibly deeper. Application has been made to the Defense Minerals Exploration Administration for Federal financial assistance on the project.

The 80-deg incline, which is following the dip of the ore structure, has exposed

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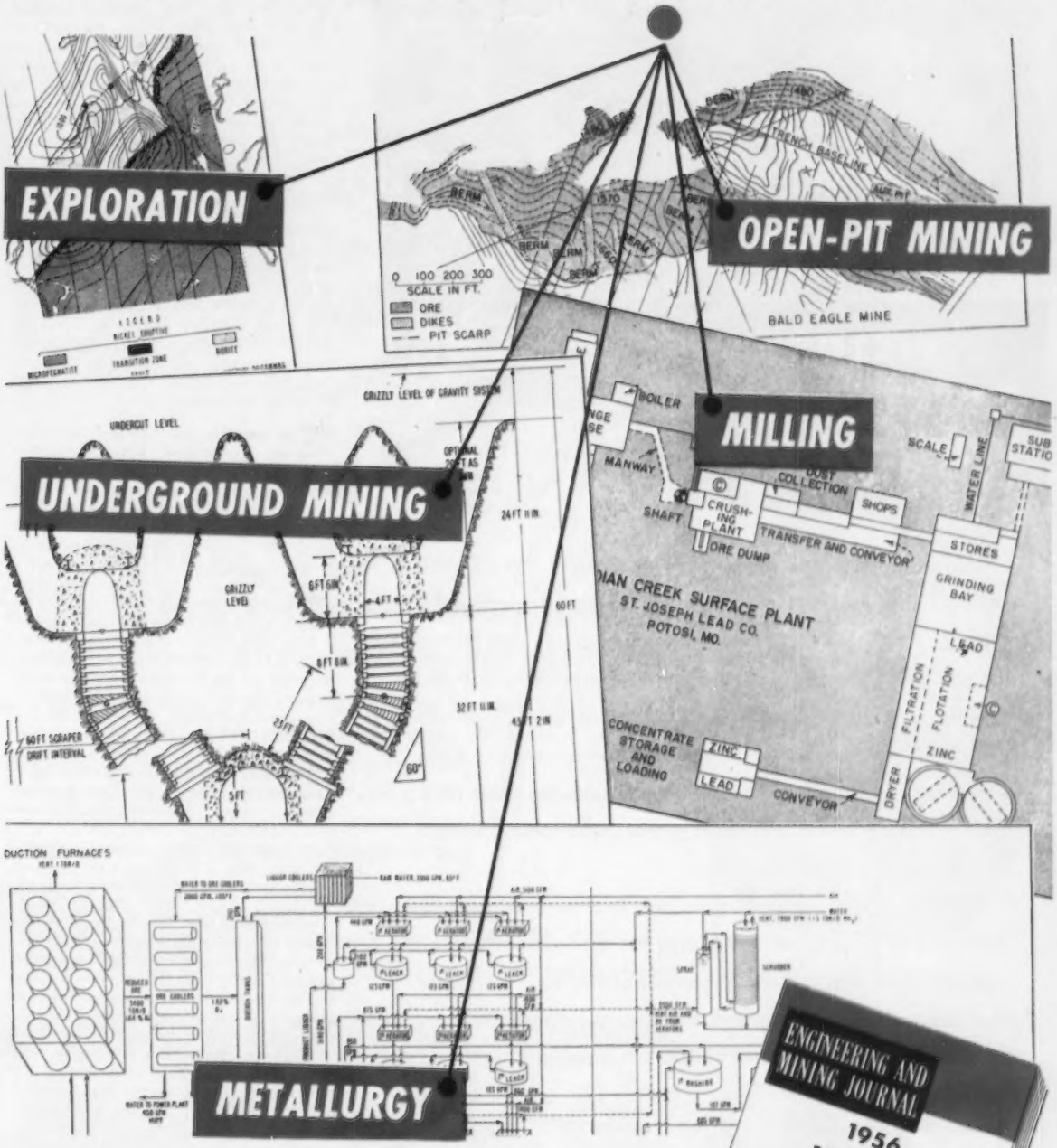

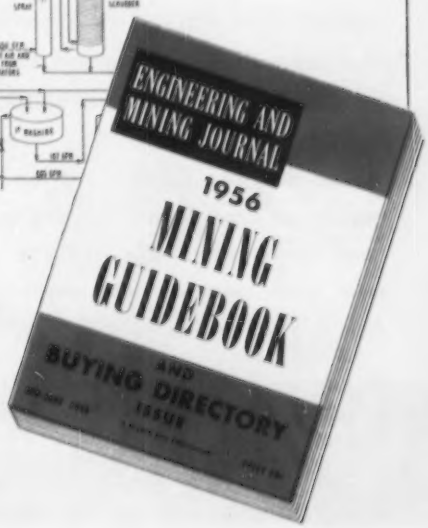

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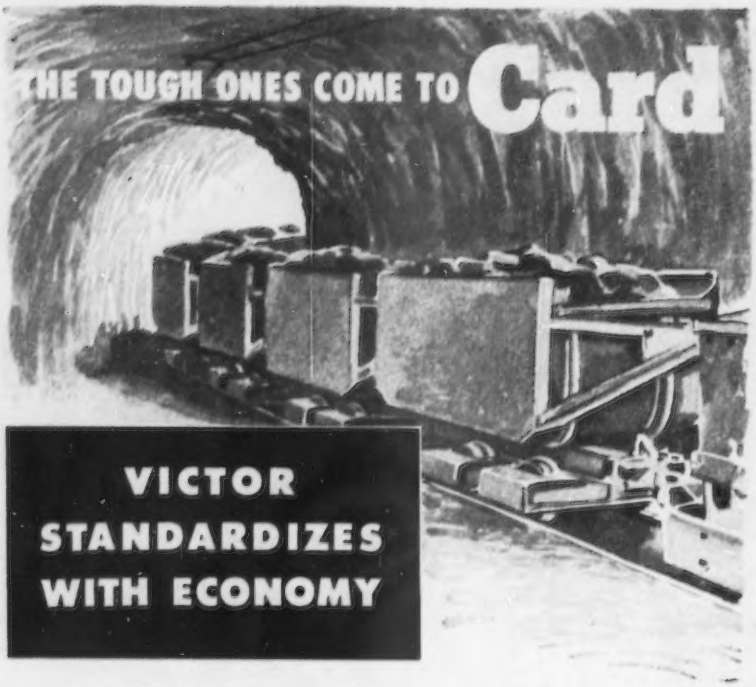
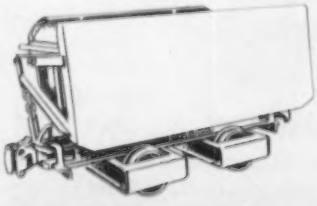
Whether you're working on a specific problem, looking for ideas or seeking helpful operating data, it will pay you to check E&MJ's 1956 Guidebook first. It contains the largest section of useful operating information ever published in any one mining magazine. You'll also find the Buying Guide an easy-to-use, up-to-date reference to the thousands of products manufacturers offer. E&MJ's Mid-June Mining Guidebook Issue is an annual service for all E&MJ subscribers.



The Maiden Rock Mine of Victor Chemical Works first started using Card cars in 1950. Chosen design was a Granby type car of 57 cu. ft. capacity built on 24" gauge and featuring coil spring suspension. The phosphate rock being handled is relatively clean to handle, and the car design is unusually well suited. As a result, not a single Card car has ever had any significant repairs although some wheels have been replaced. Fifty-two of these cars are now in service, representing several re-orders over a four-year period.

Much of the haulage at Maiden Rock is underground, and many of these Card cars seldom see the light of day. The steady day in, day out service record of the cars has meant high production with remarkable economy for Victor—one of the three largest producers of elemental phosphorus.

Standardize your haulage with an economical Card design. Our engineers can furnish an efficient car to meet your most difficult specifications.



C.S. Card Iron Works Co.
2501 WEST 16th AVE.,
DENVER, COLORADO

Idaho *(Continued)*

an average width of about 3 ft of high-grade lead-zinc ore running as high as 45% combined metal, exclusive of silver, with milling-grade material in both walls. Development muck treated in the company's 250-ton concentrator has ranged from 8½ to 14% combined lead and zinc, even after the dilution from the 7½-ft cut necessary for the two-compartment winze. Smelter returns are expected to total $6,000 a month or more.

American Smelting and Refining Co. has completed the raise extending the old Callahan winze at the Vulcan-Galena mine west of Wallace from the 1600- to the 2400-ft level. Hoisting facilities are being installed on the adit level to provide an auxiliary service shaft to the lower workings—principally for handling materials and men, freeing the main shaft for ore-hoisting.

Regular monthly subscriptions will finance Westore Exploration Co. of Osburn, newly incororated by Coeur d'Alene and Spokane interests to undertake mining explorations and investigations throughout the Inland Empire and the Northwest. The group of member-shareholders is not to exceed 500. Negotiations for a likely-looking prospect in Montana have already been started and a number of other properties are being investigated.

The new firm is headed by Howard Cameron of Osburn, former assistant secretary of the Northwest Mining Association. Directors include Archie McKinley, general manager of Sidney Mining Co.; Earl Mithaug, Sunshine Mining Co. acountant; Alden Hull, Wallace attorney; Robert Rice, Osburn mining contractor; Ervin Scheller, Osburn bulldozer operator who for several years specialized in surface exploration of mining claims; William Anderson, Osburn; James Lamphere, Wallace; Ben Dickerson, Kellogg; and Stanley Bolon and Albert Johns, Spokane.

Washington Water Power Co. has extended electric power service to the Conjecture mine in the Lakeview District of Bonner County from its 230,000v Cabinet Gorge transmission line through installation of a specially-designed transformer—the only one of its kind in the world—which steps down the power surge 500 times. This experiment in siphoning off a trickle of power from the high-capacity line was said to be roughly comparable to halting a crack transcontinental train to pick up a can of milk.

The Conjecture had been using a portable diesel-powered generator for its power needs but this equipment was inadequate to meet the growing requirements of the operation. The 52-ton special transformer unit had to be hauled over 23 miles of narrow, twisting mountain road to the mine site.

Frank N. Marr, Spokane mining man and president of Spokane-Idaho Mining Co., has taken over the lease operated for many years by John George of Kellogg in old upper workings of the Bunker Hill Mine at Kellogg and has started rehabili-

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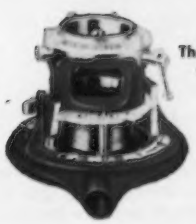

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Idaho *(Continued)*

tation of both the underground workings and the mill in preparation for stepping up production from the current 60 tpd. Operation employs about 25 men, ranking it as one of the largest leases in the Coeur d'Alene district.

Royal Mining Co., reorganized successor of St. Joe Lead & Silver Mines Co., has a new development program underway at the old St. Joe property at the head of Terror Gulch north of Osburn. Extension of the No. 4 lower tunnel is now in progress under the direction of J. V. Grismer, company president, with less than 500 ft to go to reach the projected downward extension of the old St. Joe vein at a depth of about 1,000 ft below the surface outcrop. Work is being financed by eastern interests headed by Charles Oster of New York, former president of the St. Joe firm.

Fire destroyed the mill at Holly Minerals Corp.'s mercury mine in the Yellow Pine District of Valley County near Stibnite, necessitating a suspension of operations at one of Idaho's leading quicksilver producers. Damages were estimated at $150,000. The property, known as the Hermes Mine, was operated by United Mercury Mines Co. of Boise until early this year when it was purchased by the Holly firm.

Idaho's 1954 dredge mining control initiative is slated for its first court test in the near future as a result of the decision by the State Land Board early in August to cancel the gold-dredging permit under which Clearwater Dredging Co. has been operating since 1952 on the Crooked River in Idaho County about 55 miles southeast of Grangeville.

Vernon B. Finch, owner of the dredge, has announced that he will fight the decision in court on the grounds that the law is unconstitutional because it does not establish standards on how clear the river must be kept and because it is discriminatory in applying only to dredges which handle more than 500 cu yd of material daily.

The land board ruled that Finch had failed to keep the river water "reasonably" clear and as a result had harmed fish-life in the river, as claimed by the Grangeville Wildlife Association. Finch denied this and said he would continue the operation under a new permit pending the court's decision. The dredge handles from 1700 to 2,000 yd gravel daily, with a crew of 10 men, and accounts for most of Idaho's gold production.

KENTUCKY—ILLINOIS

In anticipation of Government stockpiling programs for both metallurgical gravel fluorspar and acid grade flotation concentrate, Minera Oil Co., Fluorspar Division, with properties in Hardin County, Ill., expanded its milling and mining operations during the summer months.

At the Crystal mill, lead and zinc sulphide circuits were completed to enable treatment of reserves of sulphide-bearing

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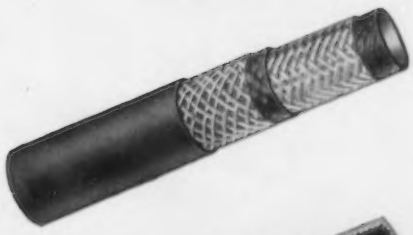

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Tacoma City Light Photo

NEW DAM UNDER WAY IN LAND OF LEWIS AND CLARK — Shown high above the Cowlitz River, near Mayfield, Wash., these workmen are making blast holes with 1-in. hexagon and 1½-in. round Bethlehem Hollow Drill Steel, to prepare the cliff face for construction of an abutment for Tacoma City Light's Mayfield Dam. The concrete-arch dam is part of a $138,100,000 hydroelectric project for City of Tacoma. It will have gravity wings and thrust blocks, and upon completion will be 185 ft high and 850 ft long. Its spillway section will be 205 ft wide.

Contractors: Arundel Corporation and L. E. Dixon Co. Tunnel subcontractor: Gibson & Roberts, Inc. Drill steel reconditioning: Senter Tool Service.

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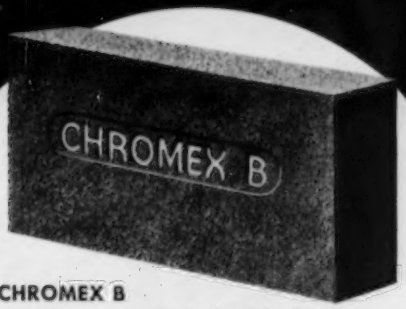

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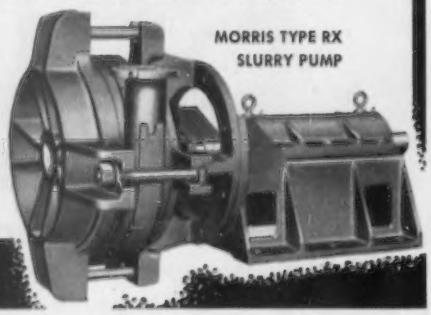

MORRIS TYPE RX SLURRY PUMP

Ky.-Ill. *(Continued)*

flourspar ores in both the Crystal and Victory properties.

The old Victory mine workings have been completely re-developed for underground Diesel truck haulage.

Minerva also has re-developed the old Defender workings, of the Austin properties, which outcrop on the east side of Spar Mountain, and has carried out an extensive drilling program in old stopes there.

The U. S. Geological Survey currently is engaged in a survey of fluorspar mines in the Ky.-Ill. district. R. D. Trace, representing the Government commission, is in charge of the survey with headquarters in Marion, Ky. Survey of the Western area already has been completed by Dr. R. E. Alstine, head of the fluorspar division of USGS.

Hearing before the Office of Defense Mobilization on an application for a fluorspar import quota has been deferred for 60 days. Originally scheduled for June 27, it was postponed until Sept. 13 and subsequently re-set for November. The application, filed by independent fluorspar producers, is based on the contention that foreign importation is endangering national security.

Exploratory work on the "Lost 40," fluorspar property in Pope County, Ill., has been started by Alcoa's Fuorspar Division. It is a low grade, marginal property, and present exploration is in treacherous ground.

LOUISIANA

Kaiser Aluminum & Chemical Corp. is constructing a $70-million alumina plant on the Mississippi River at Gramercy.

The plant, to have an initial capacity of 430,000 tons of alumina per year and include production of caustic soda and chlorine, is laid out so that it can be readily expanded. It forms part of Kaiser Aluminum's current expansion program which includes construction of a large aluminum reduction plant and adjacent aluminum sheet and foil rolling mill on the Ohio River at Ravenswood, W. Va. The Gramercy plant will process bauxite from the company's mines on the island of Jamaica.

MINNESOTA

Railroad freight rates on iron ore from the Mesabi, Vermilion and Cuyuna Ranges to Duluth have been raised from $1.13 ot $1.20 per ton.

Sherman group of mines of the Oliver Iron Mining Division was the largest mover of stripping during 1955 with a total of 6,049,483 cu yd. It also had the largest shipment of iron ore: 6,382,955 tons.

Erie Mining Co.'s taconite property at

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save more money per hour on any job!

GENERAL L. C. M. 24 PLY 16.00-24/25
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COST PER TIRE HOUR OF SERVICE

AVERAGE COMPETITIVE	.259
GENERAL LCM NYGEN	.224

SAVINGS

PER TIRE PER HOUR	$... .03½
PER HOUR 10-TIRE TRUCK	$... 0.35
ONE TRUCK 10-HOUR DAY	$... 3.50
ONE TRUCK 200 DAY YEAR	$... 700.00
50 TRUCKS-200 DAY YEAR	$35,000.00

*FROM ACTUAL SERVICE RECORDS

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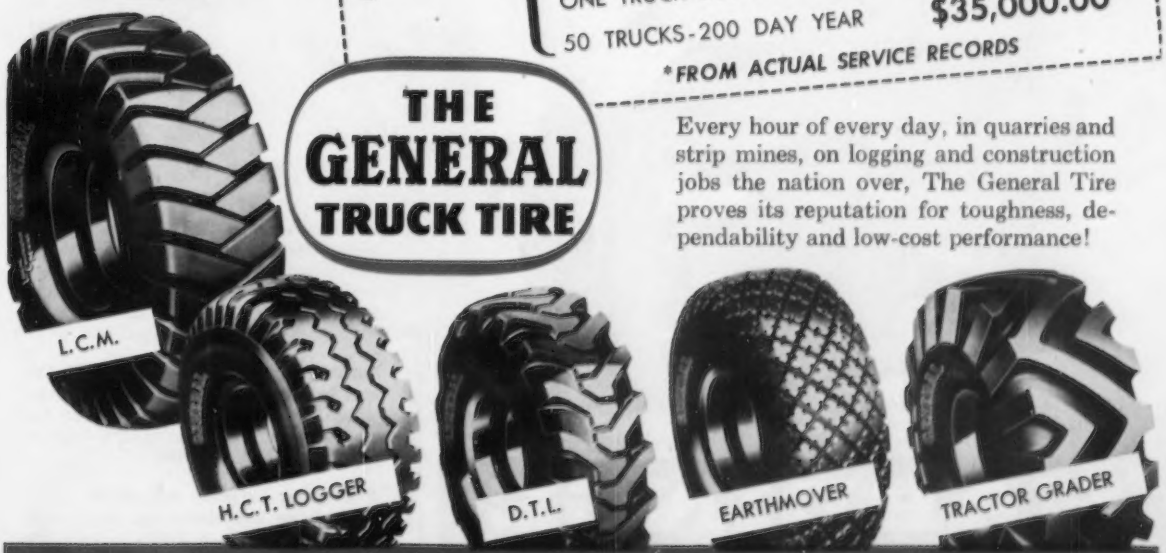
Every hour of every day, in quarries and strip mines, on logging and construction jobs the nation over, The General Tire proves its reputation for toughness, dependability and low-cost performance!



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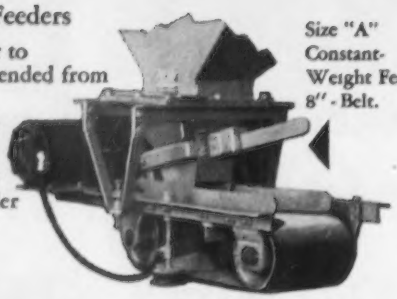
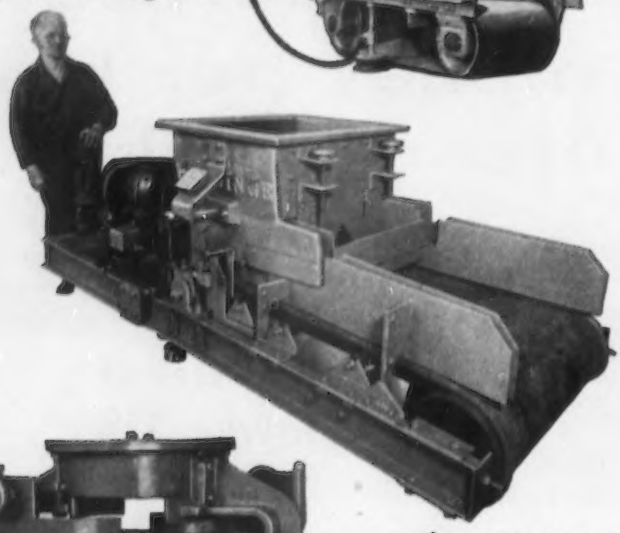
LOW INSTALLED COST

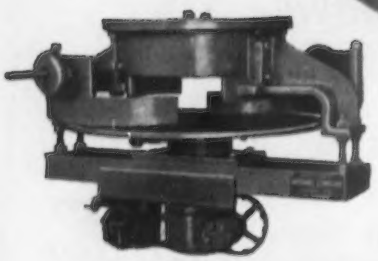
All **HARDINGE** Feeders from 100 POUNDS/hour to 100 TONS/hour are suspended from the feed bin which:

- Eliminates costly feeder support structure
- Provides accessibility to equipment following feeder



Size "A" Constant-Weight Feeder, 8" - Belt.

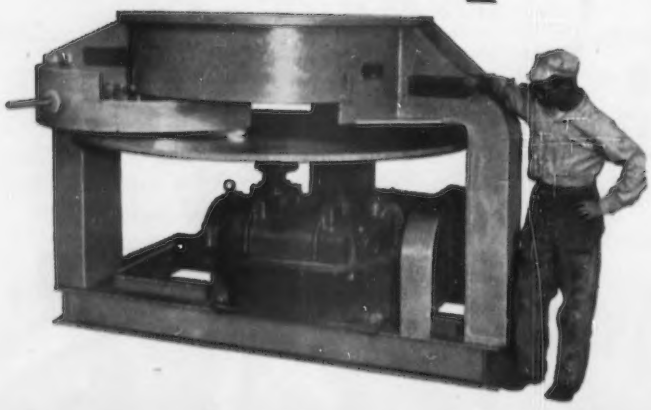




Size "D" Constant-Weight Feeder, 36" - Belt.

30" Disc Feeder

84" Disc Feeder



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Minnesota *(Continued)*

Aurora was second in stripping yardage with 4,356,023 cu yd. St. Louis County had a total stripping yardage of 42,772,-522 yd while Itasca County had 16,348,-705 and Crow Wing County (Cuyuna Range) had 3,883,692.

While the Mesabi Range shipped 64,807,-000 tons of iron ore during the 1955 ore season, its estimated reserves decreased by slightly under 28-million tons due to new drilling and the inclusion of material which has not formerly been considered as commercial crude ore.

Hibbing village council held a public hearing Sept. 4 on the vacation petition of the Oliver Iron Mining Division, the M. A. Hanna Co. and various fee owners and property holders in North Hibbing. The area covered by the petition comprises about 50% of the streets and alleys in North Hibbing to be vacated under the agreement between the village of Hibbing and the mining companies. The village has already received $250,000 for the old North Hibbing library. Total amount agreed on for the sale of the village's equity in North Hibbing was $750,000. The agreement calls for payment of the remaining $500,000 after the library sale on a pro-rata basis as the streets and alleys are vacated.

Minnesota State Executive Council has received 37 bids for permits to prospect for iron ore or taconite on 17 mining properties owned by the state. The bids were made by 14 mining companies. The Bruce Annex at Chisholm, which adjoins the Bruce mine, and has an estimated tonnage of 387,372 tons; and the Mississippi No. 2 at Keewatin, a mine which has shipped up to this season 1,047,625 tons and has an estimated 30,000 tons remaining, had six bids each. The old lease on the Mississippi No. 2, which was operated in 1955 by Pacific Isle, has expired. The Bruce and Bruce Annex were formerly operated by International Harvester Co.

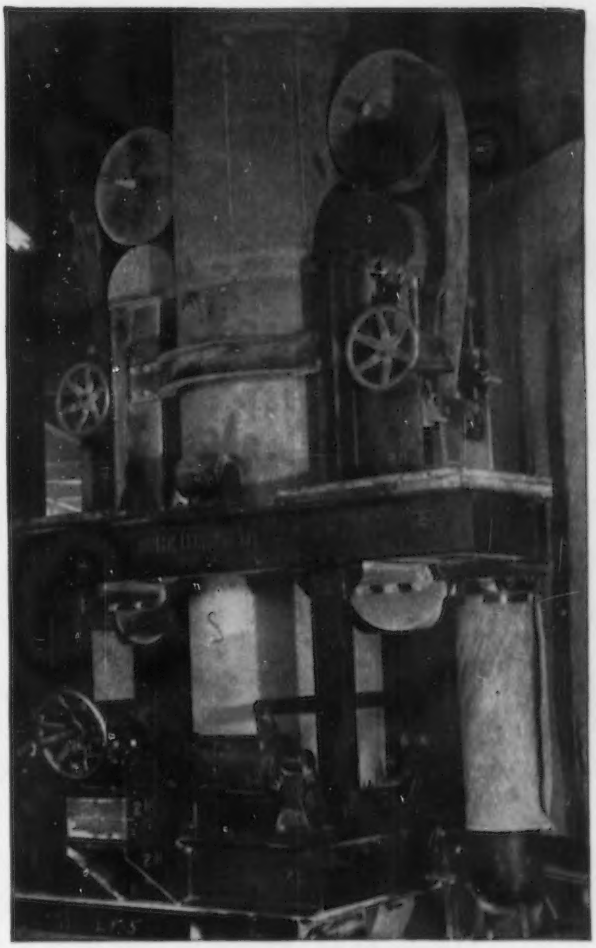
MONTANA

Contract for 500 ft of exploratory diamond drilling has been let by Moose Hill Mining Co. on its 10-claim tungsten prospect in Lincoln County near Libby. Tungsten ore of commercial grade was discovered on the claims last year.

Burmac Exploration Corp. of North Dakota has been granted a $15,512 contract by the Defense Minerals Exploration Administration for exploration of a uranium prospect in Fallon County.

A fluorspar discovery believed to be of considerable importance has been made at the headwaters of Fish Creek on the Idaho-Montana border in the southern part of Mineral County. The find was made by Mort Bacon, rancher and guide, in an area where he has frequently taken hunting and fishing parties. Bacon and

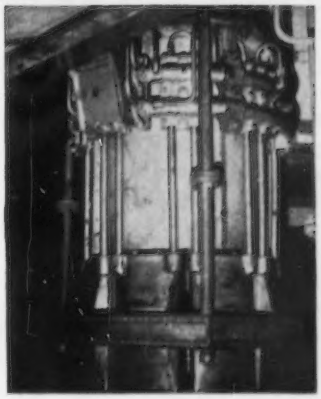
At Ferro-Metals in South Africa, Lectromelt* Furnace Equipment



DEPENDABILITY designed and built into Lectromelt furnace equipment accounts for its widespread use around the world. Because furnaces are often installed at mine mouths and other out-of-the-way places, they must operate with a minimum of downtime for repairs.

VERSATILITY demonstrated by Lectromelt furnaces throughout the past forty years makes them readily adaptable to variations in processes. Experience gained by Lectromelt engineers on electrothermic problems enables them to advise you on the use of electric-arc furnaces in high temperature chemistry.

For this help and for a copy of Catalog No. 105, write Electrothermic Division, Lectromelt Furnace Company, 322 32nd Street, Pittsburgh 30, Pa. (a McGraw Electric Company Division).



Two 7500 KVA Lectromelt Furnaces with 35-inch self-baking electrodes are employed by Ferro-Metals on ferroalloys and ferrosilicons.

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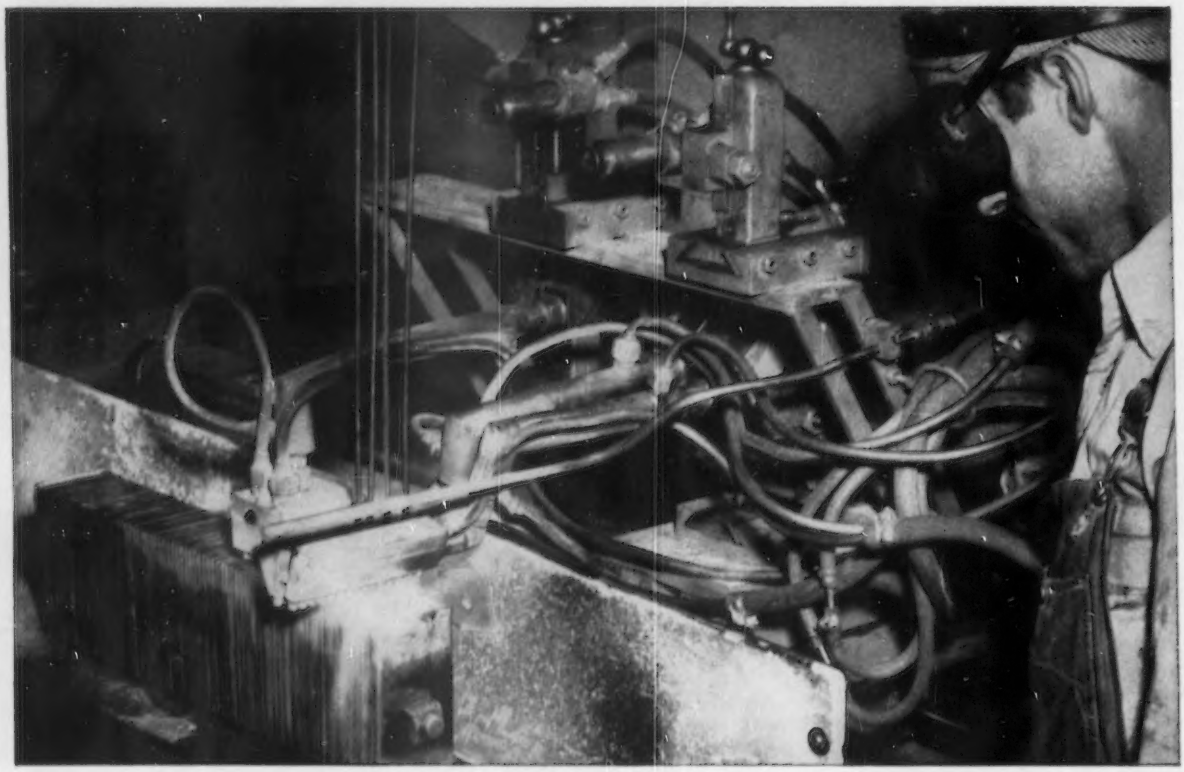
WHEN YOU MELT... *Lectromelt*



Hammer Life Increased Four Times by **HARD-FACING**

Hard-facing with HAYSTELLITE tube rod has increased the life of hammers used in a heavy duty grinder by four times. The hammers rotate at from 3000 to 3600 revolutions per minute while pulverizing limestone, mica and other severe abrasives. They are hard-faced mechanically on a model 800 straight-line machine. Seventy hammers are processed at a time, and 1000 hammers are hard-faced in a normal working day.

HAYSTELLITE rod, the hard-facing material used on the hammers, forms an extremely hard surface that has good resistance to impact. It produces a deposit of sharp, irregularly shaped particles of cast tungsten carbide evenly distributed in a matrix of tough steel. The tungsten carbide particles resist abrasion, and the steel matrix cushions the effects of sudden shock.

There are 18 HAYNES hard-facing alloys . . . a wide selection that guarantees you the right rod at the right price for every wear problem. These hard-facing rods have achieved excellent results in the earth moving and quarrying industries when used to protect such parts as cable drums, hammers, crusher rolls, bucket teeth, and conveying screws. They can be the economical answer to your wear problems too.

Ask your local HAYNES STELLITE dealer for a copy of "HAYNES Hard-Facing Manual." It contains descriptive information and application data on the complete line of HAYNES hard-facing alloys. If you don't know the location of your local dealer, write to Haynes Stellite Company, a Division of Union Carbide and Carbon Corporation, Kokomo, Indiana.

See... Your local Haynes Stellite Dealer

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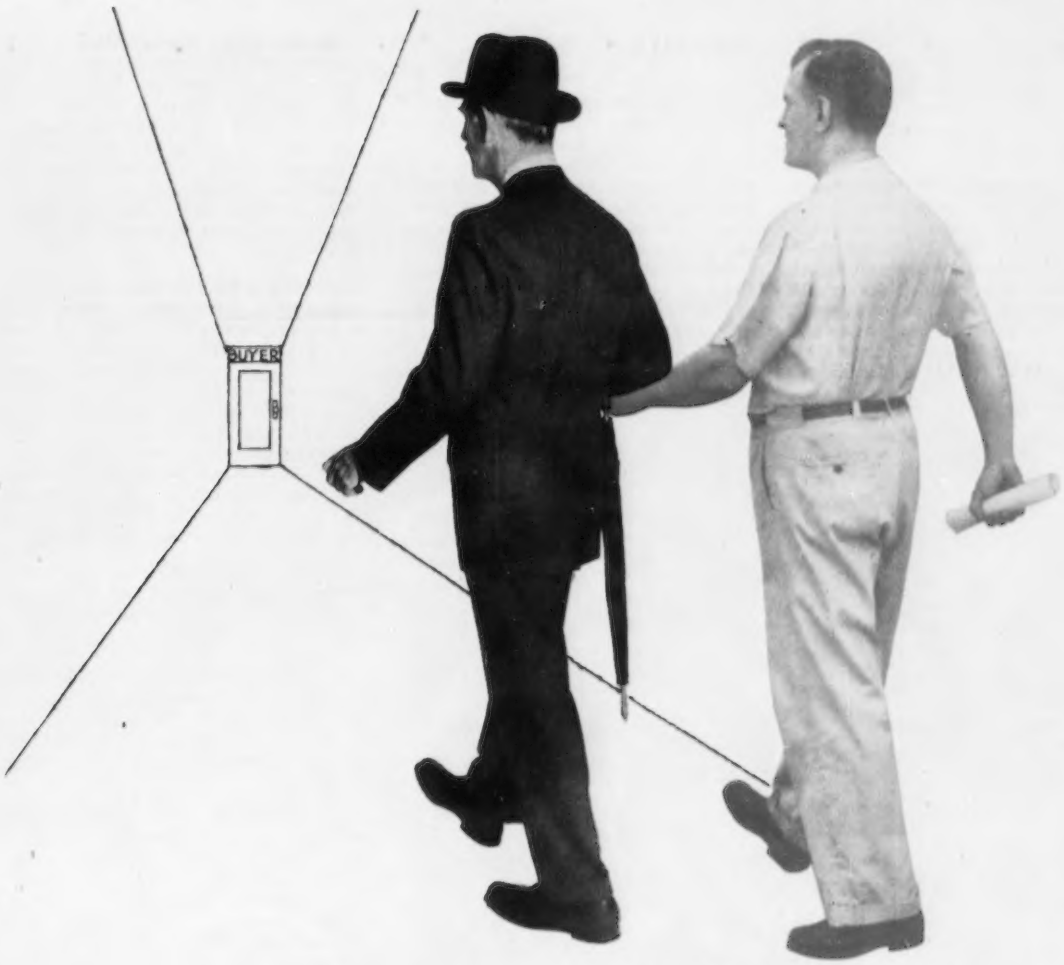
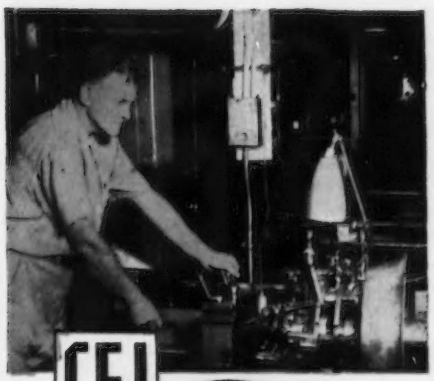


Your Wickwire Rope Distributor and our closer operator ...ready to help you



This closer operator—running a machine which forms our rope—is with your Wickwire Rope Distributor every time he makes a call.

True, he's physically in the mill, where he's carefully conducting this final fabricating operation. But, whenever your Wickwire Distributor makes a call, he has the full assurance that every foot of Wickwire Rope has been carefully assembled by skilled craftsmen . . . and that it will give you long, trouble-free service on your job.

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Montana *(Continued)*

his associates, Oliver E. Lord, Joseph Farrington, Carl Reinhard and Melvin Davis, reportedly have been offered $100,000 for the claims.

Western Resources Inc. of Spokane has located 16 additional claims around the 20-claim uranium prospect which it acquired last fall in Mineral County east of Saltese and is making plans for an extensive development program, including additional bulldozer stripping and diamond drilling. The mineralized zone has so far been exposed over a length of about 225 ft and is up to 70 ft wide in places.

NEVADA

Still another cavern has been discovered by Consolidated Eureka Mining Co. at its Eureka, Nev., lead-gold-silver mine. Officials of the Salt Lake firm report the new cavern was found in a drift off a cross-cut on the 400-ft level which was aimed at developing ore beneath the cavern found earlier on the 300-ft level.

Considerable high grade ore is being found under the 300-ft cave and anticipation is that ore also will be under the new cave on the 400-ft level.

Belco Petroleum Co., New York, has acquired the Cahill Mercury Mine in northern Humboldt County, and all the property of the Northern Resources Corp. in the same area. Housing facilities have been enlarged and the payroll has been increased from 25 to 36 men. The property lies in the Paradise Valley area and much ore is being produced. Herbert N. Witt, of San Francisco, is consulting engineer, and James G. Goldworthy is superintendent.

Consolidated Virginia Mining Co. has announced decision to resume mining on its extensive holdings in the Comstock Lode in the Virginia City area. Louis H. Seagrave, president of the firm, said the program will include open pit operations and drilling in virgin areas to confirm previous assays which show high values to exist there. Con-Virginia properties on the Comstock have produced more than $220-million in gold and silver, but have not been operated since 1942 when the Government shut down gold mining.

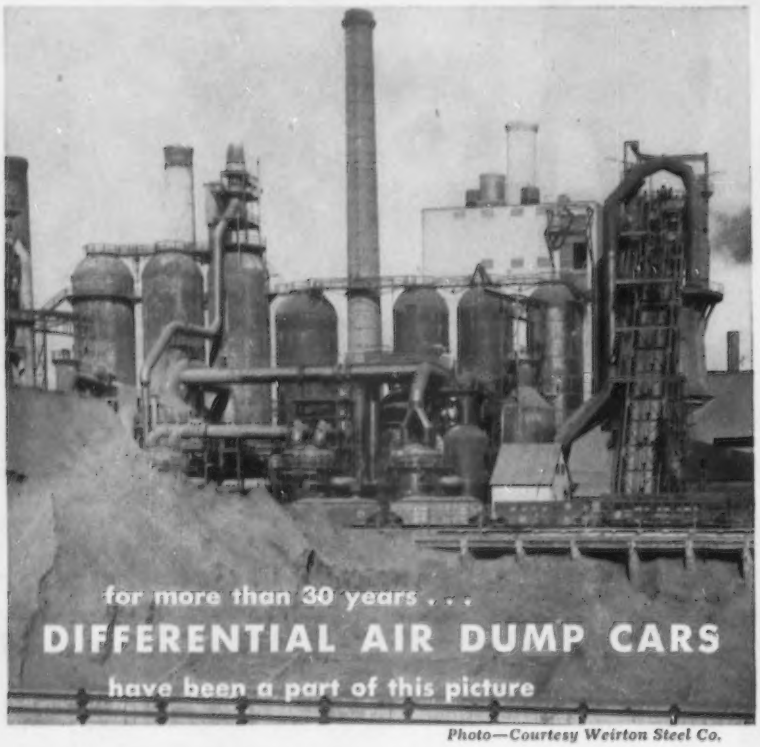
Titanium Metals Corp. has acquired a 15-year lease on the Pioche Manganese Co. properties at Henderson. The deal includes power, water and utility rights of the Pioche firm as well as a 75-acre site. This increases Titanium Metals' holdings to 300 acres and makes it one of the largest plants in the Henderson area. The action was in keeping with Titanium's plans to expand its production facilities by 67%.

C. C. Coppin and G. A. Harrison began retorting high grade cinnabar ore from their Redbird mine in Pershing County during August. The property is situated in the Antelope Springs district, and two retorts fired with coal are being used. Roasting is completed in eight hours when the ore is broken down to 1-in. size. There are 60 tons on the dump as a result of development work done under a Government loan. This work, completed early in August, consisted of drifts run on the haulage level to distances of 250, 80 and 90 ft. A winze was sunk from that level for a distance of 755 ft, and a drift run from it for 58 ft. The ore is being mined and raised to the hauling level with an air lugger.

Standard Slag Co., which mines and processes large quantities of manganese at Gabbs, is expanding its iron mining operations in Nevada. During the first six months of 1956 ore shipments by the company averaged 40,000 tpm, all of which went to Japan.

NEW MEXICO

Ambrosia Minerals, Inc., Albuquerque, revealed that the company's manganese mining and milling operations alone will gross $1-million by Dec. 30, 1956. Information was part of an engineering report stating that Ambrosia is currently shipping one carload of manganese concentrate daily, with an expansion of milling operations soon to up shipments to two cars daily. First shipments averaged 43% manganese.



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A substantial growth in sales — including many repeat orders — reflects a recognition of the quality and performance built into Differentials.

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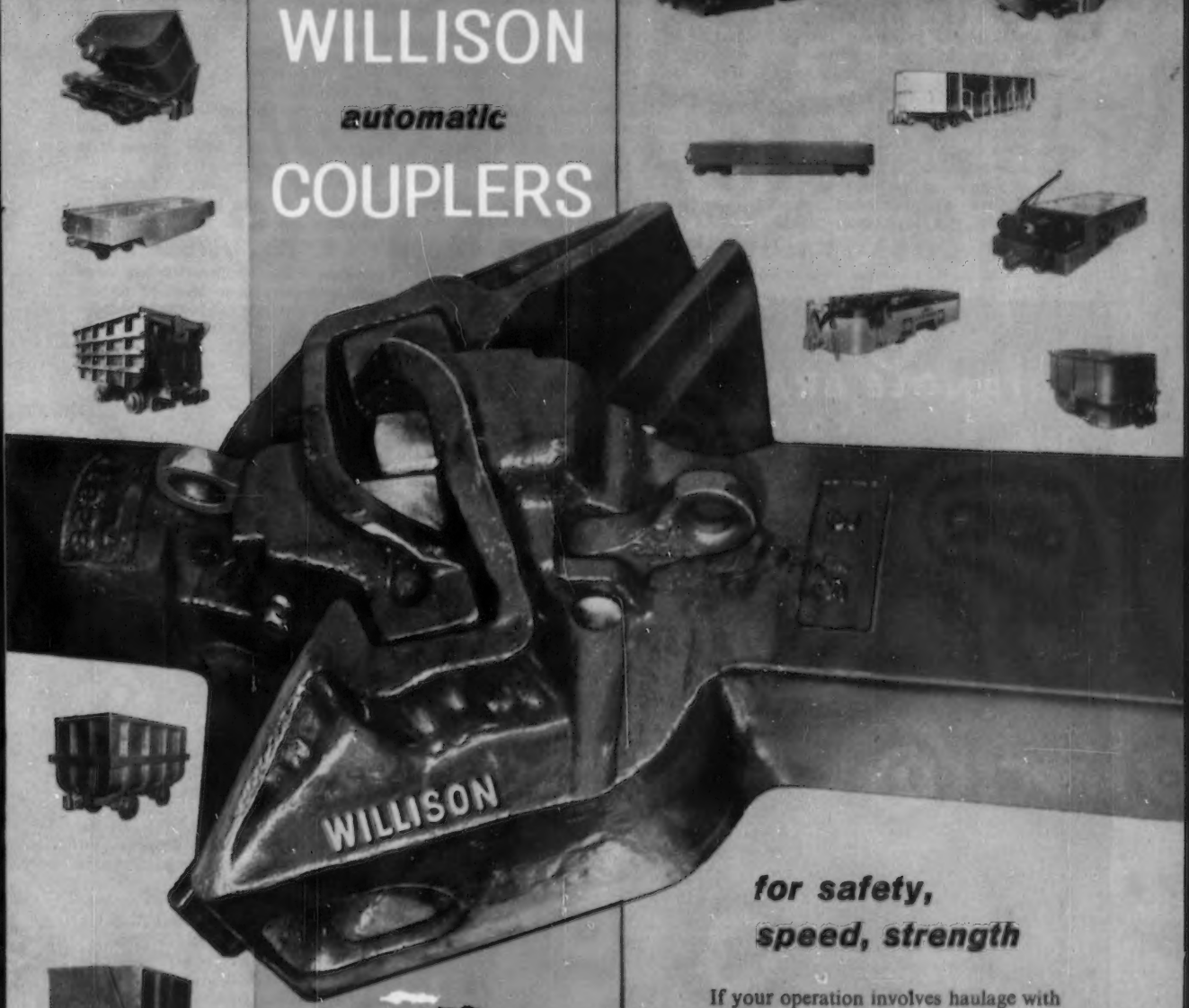

for safety, speed, strength

If your operation involves haulage with locomotives and cars in the 1 to 30-ton range, it will pay you to investigate the advantages of Willison Automatic Couplers.

Willisons are *Safer*—because they couple automatically... *Faster*—because they're self-aligning... *Stronger*—because they take the full buff and pull forces without depending on intermediate parts.

Over 100,000 Willison Automatic Couplers are in daily use in mines, industrial plants and foreign railroad service because they're *safer... faster... stronger.*

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MINE AND INDUSTRIAL CAR TRUCKS • NACO STEEL WHEELS
NACO STEEL LINKS AND SWIVEL HITCHINGS

UTAH

Due date of the $2.8-million loan to Mountain Mesa Uranium Corp. from Hidden Splendor Mining Co. (Atlas Corp.) with which MMU purchased the Cal-Uranium mine has been extended ten months from Oct. 1, 1956 until Aug. 1, 1957.

H. O. English, Casper, Wyo., president of Mountain Mesa, said in report to shareholders that:

"Since we acquired Cal Uranium (from the M. K. Ruddock interests) we have been considering several different methods of paying off this loan from Hidden Splendor.

"One of the methods was a public offering, first to the present stockholders and then to the public, of which Hidden Splendor had the right to accept 20% of any such offering. In considering the application to the Securities and Exchange Commission, we felt it necessary to obtain more comprehensive reserve information. We drilled 50 new holes of which 43 were drilled in the San Juan (Cal Uranium) orebody and on its fringes.

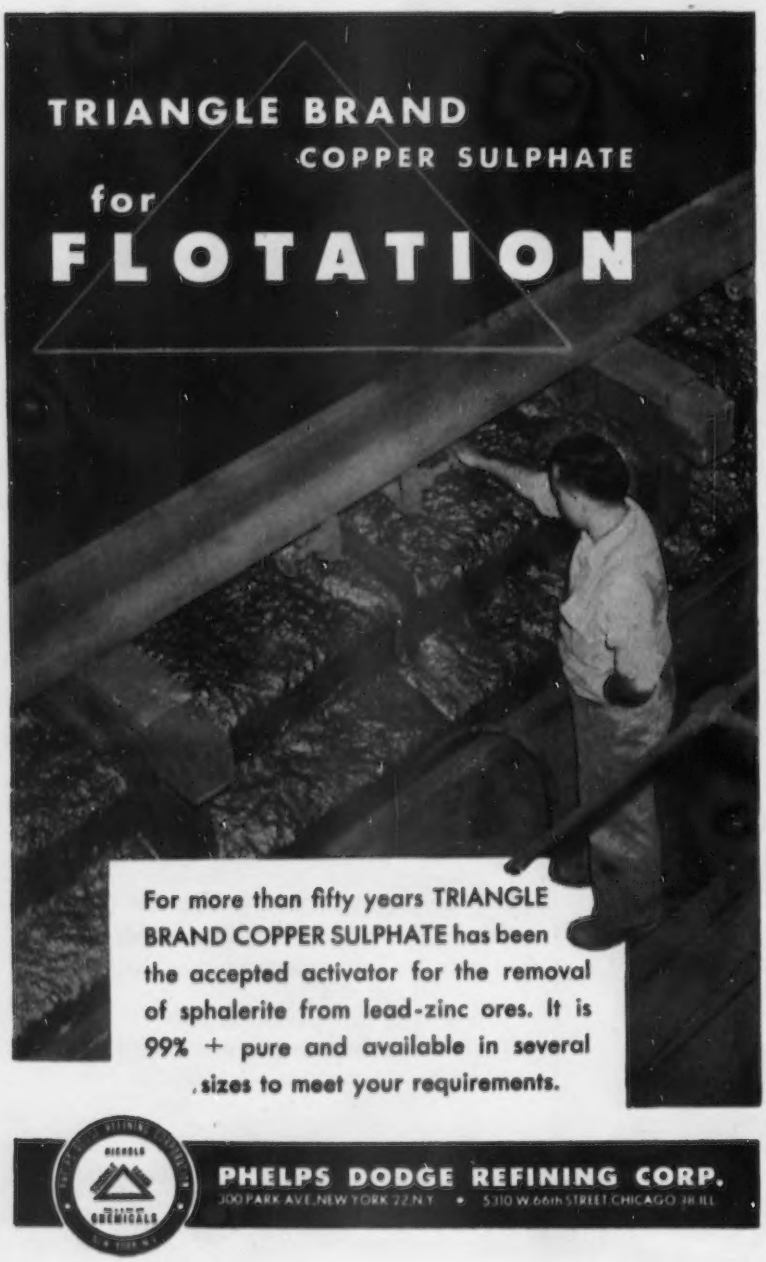
"We drilled seven holes on a thin ore deposit on the Small Fry claims which are about one-half mile south of the San Juan orebody.

"At present stage of exploration, the San Juan orebody is very well drilled, however, there are approximately 23 claims on the Cal-Uranium property which have not been fully explored.

"As the result of this drilling, over-all grade of the orebody was reduced from approximately 0.30% U_3O_8 to 0.20% U_3O_8 but we were successful in increasing the amount of relatively low grade ore appreciably.

"Under these circumstances, we realized that our substantial reserves of low grade would require some special equipment to market on a commercial basis."

English said that a research laboratory of Dallas, Tex. had been employed to work out a process for handling the low-grade—process is now under evaluation.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Vanadium Corp. of America has completed arrangements to lease 42 mining claims on a royalty basis in the Marysvale District of Piute County from Marysvale Uranium Co.

The claims are west of VCA's present mine—only fissure type uranium producer in U.S. and cover some 850 acres of ground.

VCA also announced purchase of one-third interest in 27 uranium-vanadium mining claims in Long Park area of Mesa County, Colo. The carnotite properties were owned by T. C. and Henry Brameier and cover 550 acres in the Eagle Basin group.

American Gilsonite Co. will build two shorter spans rather than one of the longest pipeline suspensions in the world in constructing a gilsonite carrying system from Bonanza, Utah, to near Grand Junction, Colo. (See *E&MJ*, August 1956, p. 146.)

Contract has been let to Consolidated Western Steel Division of United States Steel Corp. to build one 700-ft span across the White River. A mile farther east, the steel firm will build a 600-ft span across Evacuation Wash.

As originally conceived, the pipeline carrying a gilsonite-water slurry would have leaped both the White and Evacuation Wash in a 1,300-ft span.

Engineers Ltd. have been given contract for laying the 70-mile line from the mine at Bonanza to Grand Junction.

The facility will transport the gilsonite to a coke-refiner and high-test gasoline producer AGC is erecting at Gilsonite, Colo. just south of Grand Junction.

Uranium Discovery & Development Co. and Uranium Mines, Inc., both of Wallace, have acquired a joint 20% gross royalty on the mine proceeds from 106 of the 162 lode claims which comprise the Ransom Brothers' uranium mine in the Cottonwood Wash area of San Juan County, west of Blanding. A similar royalty on the other two claims—the King Edward and the King James—both of which have commercial ore channels, was acquired more than a year ago by the UD&D company and is now owned equally by that firm, Sunshine Mining Co., and the Clayton Silver exploration division which represents Clayton Silver Mines Co., Sunshine Consolidated Inc. and Silver Syndicate Inc. Both deals were negotiated by Jay Bettles, Wallace mining promoter.

Turbo-Topics

TURBO-MIXER GENERAL AMERICAN TRADE MARK

TURBO-MIXER, a division of

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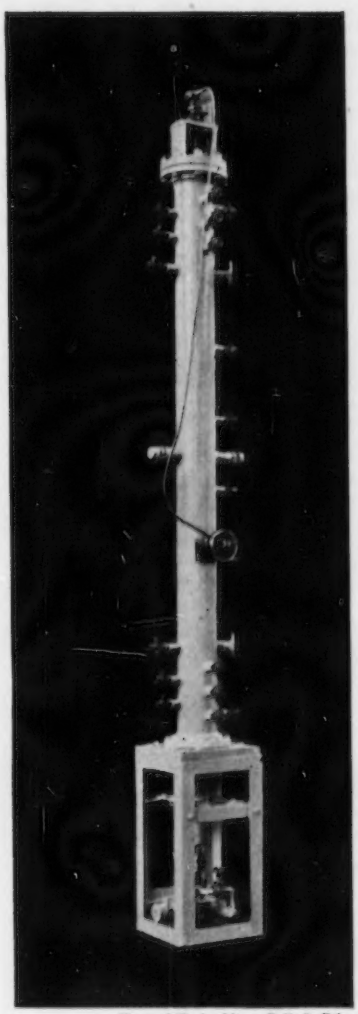

Typical Turbo-Mixer R.D.C. Pilot Column (6" x 8'0") For Research or Design Studies

Pre-Testing Proves that the Turbo-Mixer R.D.C.* Column can solve Your Extraction Problems

Every extraction problem is a bit different. That's why you benefit from Turbo's eight years of research, piloting and industrial scale installations that provide a background of experience applicable to your problems.

Even more important, our laboratory is completely equipped to make specimen runs on your materials and develop reliable plant scale design. Your engineers are invited to observe these laboratory runs. Pilot scale equipment can be built for development studies at your own plant, if you so desire.

The R.D.C. extractor offers you:

1. ***High Volumetric Efficiency;***
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3. ***Simplicity of Construction;***
4. ***Low Power Requirements;***
5. ***Flexibility of Operation.***

Our engineers are at your service for application of the R.D.C. to your extraction problem. For further information and descriptive bulletins, write today.

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Utah *(Continued)*

The recent contracts provide for an end-price of $402,500 payable by UD&D and Uranium Mines on an option basis over a three-year period.

Uranium ore producers in the Gas Hills area of Fremont County have been assured by Jesse Johnson, director of the raw materials branch of the AEC, that every effort is being made by the AEC to work out an equitable marketing program for ores from Gas Hills.

R. L. Moran, president of the Wyoming Mining Assn., protested to Johnson that the quota system for ore deliveries to the AEC's buying station at Riverton now makes it difficult for miners to plan in advance and keep a crew on hand.

Ore quotas have been established on a month-to-month basis all summer. Most uranium ore quotas for September were retained on the same basis as August.

Shipping of high grade uranium ore from its Divide Mine in the Big Indian District, San Juan County, were to begin early in September, International Oil & Metals Corp. announced.

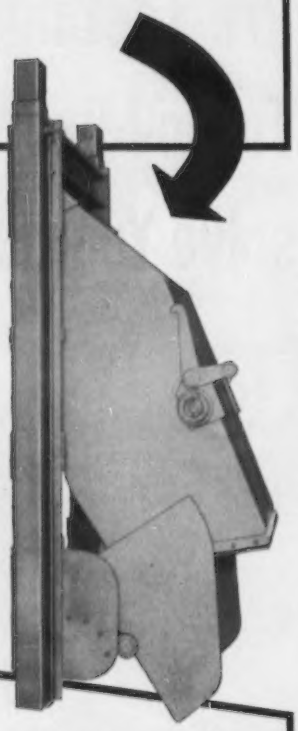
Louis H. Seagrave, chairman of the company's executive committee, said an initial producing rate of 100 tpd is planned, which will be increased to 200 tpd later. He said that production from these properties was reported to be averaging about $50 a ton and established reserves to be 250,000 tons.

At the Divide Mine, also known as the Yellowjacket, an incline shaft has been driven 575 ft to intersect a major orebody discovered late in 1955. Ore will be transported to the surface on shuttle trucks.

From Connellsville, *naturally!*

WET or DRY—
LARGE or SMALL
It's never a problem
when you are using this
QUICK-DUMPING
BOTTOM DISCHARGE SKIP

A Skip that's of uniform size from end to end . . . no obstructions for material to hang up on.



BY THE LEADER in bottom discharge skips this new skip is designed to handle all types of underground raw material. The top loading end being the same size as the bottom discharge end, there are no obstructions for wet, sticky and/or unusually large material to hang up and clog. This unique feature allows a speedier discharge cycle with very little vertical travel needed for dumping.

The skip bottom is ruggedly constructed to withstand the loading impact and a rubber seal stops all leakage.

Made in capacities from 4 to 12 tons, live load. For detailed information write—

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WASHINGTON

Daybreak Uranium, Inc., ore reserves are estimated at 55,800 tons of proven commercial ore; 461,700 tons of inferred ore; and 1,158,900 tons of potential ore. The figures were prepared for Daybreak directors by J. Fred Williams Jr., registered mining and metallurgical engineer of Pullman, who formerly headed the metallurgical department of the Washington State College School of Mines.

Company officials estimate the ore should net $10 a ton, or more than $500,000 for the proven ore; nearly $5-million for inferred ore; and more than $10-million for potential ore.

Williams report said that "deep drilling may enhance these estimates," and the company has further proven ore amounting to 56,400 tons which can be economically upgraded into a commercial product. Uranium deposits exposed on Daybreak properties can be mined by open-pit and cut methods, Williams said, and grade of the ore varies from 0.06 to more than 2%.

The $29,180 DMEA drilling program carried out by Northwest Uranium Mines, Inc. of Wallace on its uranium prospect on the Spokane Indian reservation in southern Stevens County, has disclosed more than 400,000 tons of ore averaging 0.15% uranium oxide or better, plus a substantial additional tonnage of lower grade material which could be mined by open-pit methods at a profit if suitable up-grading facilities were provided. The company is reported to be currently considering installation of such a plant at a cost of approximately $200,000.

Reserve estimates figured to date do not include the probable tonnage in a fault structure on the property which has been proved to be well-mineralized from the surface to a depth of at least 50 ft.

Northwest Uranium is owned jointly and equally by Eastern Lead Corp., Fortune Mining Co., and Silver Buckle Mining Co., of Wallace, Pathfinder Uranium Corp. of Salt Lake City, and Stansbury and Associates of Spokane.

New discovery of autunite, assaying an average 1% U_3O_8, has been made by percussion drilling on Dahl Uranium Mine, Inc. property, according to Richard Weaver, president of Mine Consultants, Inc., whose crew made strike while under contract to Dahl. A mineralized vein averaging 2½ ft thick was struck in five of six drill holes put down in exposed pegmatites, Township 28 North. Mine Consultants recommended further and extensive drilling as a large orebody may be in the offing.

Digs MORE

At Mohave Mining & Milling Co.'s sintering plant the powerful break-out action of the model HU "PAYLOADER" works the bucket into tough, heavy ore and tips it back 40° at ground level to get bigger loads, with less spillage.

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Because the "PAYLOADER" gets MORE to begin with and carries MORE while traveling at higher speeds . . . with less spillage in both instances . . . the result—you deliver MORE. "PAYLOADER" design handles more yardage at lower cost.

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Whether you want to move manganese ore like this, or larger-size ore and rock, "PAYLOADER" tractor-shovels are designed to get and hold bigger loads and deliver them faster.

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"Union Oil products protect our crusher against dust and climatic conditions which can be unbelievably bad here in Cuba.

"Sometimes our plant is deluged by tropical downpours...other times the dust gets so thick it looks like we'd had a snow storm. However, since we went into production over a year ago we've lubricated all bearings with UNOBA, and even during this rough 'shakedown' period we haven't lost a single one in the Rogers Iron Works crushers, conveyor rolls, shaker screens or anything else. In my opinion UNOBA is the finest grease obtainable for tropical operations like ours."

In spite of drenching rains and high temperatures UNOBA *stays in bearings to keep dust out*...it's truly a *multipurpose* grease. Immediately available from your nearby Union Oil representative.

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WYOMING

Discovery of a new uranium orebody on their Tee No. 1 claim in Fremont County has been announced by RanRex Mining Co. The new orebody is located in the East Gas Hills area, north of RanRex' present pit about 400 ft, and east of the Aljob pit.

Einar Erickson, geologist, says that drill hole assays have run from 0.07 to 0.15% uranium oxide. Orebody is located on a knob and is 60 ft deep at its deepest point. The ore is located in both the oxidized and unoxidized zone of the upper Wind River formation.

A valuation of $8.1-million has been set on the uranium orebody being drilled out by Gaddis Mining Co. on claims in the Crooks Gap area of Fremont County. Gaddis is selling the claims to Continental Uranium of Chicago and Grand Junction, Colo.

Announcement of the tentative valuation of the orebody was contained in a letter to stockholders from Gerald Gidwitz, chairman of the board of Continental.

"The net reserves, after mining costs, are estimated at $5-million," Gidwitz said.

He advised Continental Stockholders that Continental would pay approximately $3.25-million for the property if engineering surveys verify the Gaddis estimates. The payment will be made in the form of 125,000 shares of common stock and the balance in cash, payable over a period of 6 years as the ore is produced.

Phelps Dodge Corp. has recently contracted with the Colorado Exploration Co. of Golden, Colo., to assist its geologists and engineers in supervising the exploration of Wyoming Uranium Corp.'s holdings in the Crooks Gap District, Fremont County. The present program calls for at least 68,000 ft of drilling.

In addition, Colorado Exploration is performing engineering services for Phelps Dodge on the Mile High Minerals' claims located in South Dakota and Wyoming.

Intermountain Chemical Co is nearing completion of a new $1.25-million shaft in its Trona mine near Green River which will enable it to increase production at its mine and chemical plant at Westvaco. Intermountain's No. 3 shaft, under construction the past 10 months, "broke through" to the main mine workings at the 1500-ft level.

The shaft, 18 ft in diameter, may eventually be used for moving of men and materials, but its initial object is to increase the air intake.

The ventilation system to be supplied through the new shaft will increase the amount of fresh air circulated from 125,000 cfs to 300,000.

U. S. Yttrium Inc. has awarded a $50,000 contract to Spiegelberg Lumber & Building Co., Laramie, for construction of a new plant at Laramie. The construction will utilize some of the existing facilities of the old Standard Oil refinery at Laramie.

IN CANADA

ONTARIO

Plans for the sinking of two internal shafts from 4,000 to 6,000 ft at the giant Kerr-Addison gold mine in the Larder Lake area are now being drawn up. One opening will be for production and the other for service and ventilation. New levels will not be opened until the sinking program has been completed. The mine has a very comfortable ore position having nine years' ore supply averaging almost $11 per ton.

Stanrock Uranium Mines has received a letter of intent from Eldorado Mining & Refining for purchase of $76,359,360 worth of uranium. It is planned to construct a plant with rated capacity of 3,300 tpd. Two shafts, a production shaft to 3500 ft and a service shaft to 2900 ft, are now being sunk. Mill operations are scheduled to start about Oct. 1, 1957.

Arcadia Nickel Corp. has increased estimates of indicated and proven tonnage to 2.5-million tons averaging 1.5% combined nickel-copper plus precious metals. This is based on work completed to the 1,000-ft level at its property in the Sudbury area. An additional 2.5-million tons of possible ore has been estimated to

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For proof of what this accepted 3-step technique can mean to you in keeping costs down, output up and your drillers happier—phone, or write, our nearest plant. Small or LARGE hole drilling, we have the bits for them all. Ask for Bulletin B-1.

Carbide Rok-Bits—cross, "X" or chisel types—gauge sizes: 1⅛" thru 6".

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'Jeep' vehicles GO where others can't to speed mining operations!

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'Jeep' vehicles get through when ordinary vehicles bog down in the heavy rough going of mining projects. Their rugged "go-anywhere" ability makes them ideal for use in every phase of the mining industry—from exploring or prospecting in remote areas to keeping maintenance work and service around the mine moving on schedule.

'Jeep' vehicles are the only 4-wheel drive vehicles in their weight class time-tested and performance-proved in billions of miles of transport service. They're the only vehicles originally designed and engineered completely for 4-wheel drive off-the-road use. They work for you 365 days a year. The extra traction of their 4-wheel drive takes them up steep inclines or over rocky ledges—anywhere you need to go! And they tow heavily-loaded ore trailers on or off the road—in good weather or bad.

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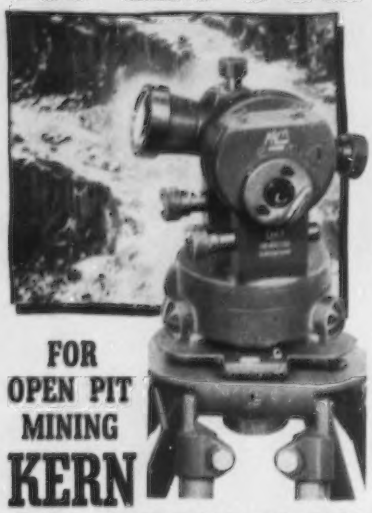

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GUNNAR MINES LTD. will this month complete delivery on its $76-million contract with the Canadian Government for uranium precipitate. The concentrating mill is in the left foreground above—a 540x240-ft building. Other buildings include warehouses, offices and housing. On the right are the oil storage tanks. The pit, where six levels in underground operation were opened this past spring, is on the shore of St. Mary's Channel, of Lake Athabaska's Black Bay, Saskatchewan.

Ontario *(Continued)*

depth of 1700 ft.

A development program is under way to open up a block of seven new levels at the gold producing property of New Dickenson Mines in the Red Lake area. The new levels were established following completion of a sinking program which carried the shaft to depth of 2,370 ft. Production this year is at record levels. In the first six months output was valued at $1,272,535 from treatment of 77,757 tons, against $1,108,734 from 71,432 tons in the same period last year.

Production plans are being drawn up by Canadian Charleson Ltd. for its iron property adjoining Steep Rock Iron and Caland Ore Co. Construction of a beneficiation plant is being considered for next summer with production expected by the following summer. Substantial deposits of hematite-bearing gravel have been outlined by diamond drilling to date. Company is a wholly-owned subsidiary of Charleson Iron Mining Co. of Hibbing, Minn.

Wabico Mines has started a surface exploration program on its 11-claim copper prospect in the Emerald Lake sector of the Temagami area. A strong anomaly was indicated by an aerial electromagnetic survey and ground geophysical surveys are now being carried out to further define the anomaly. Diamond drilling will start as soon as the surveys have been completed.

Preliminary development of a new deep orebody at Campbell Red Lake Mines in the Red Lake area is giving promise of good tonnage of rich ore. It is now being opened from the new block of levels extending from the 14th to the 9th level. In addition work on the new levels has shown extension of the upper level orebodies with grade improving with depth.

Sinking of the 4-compartment shaft at the copper-zinc-silver property of Willroy Mines in the Manitouwadge area is now nearing completion. Four levels are to be opened to depth of 875 ft with drives to be pushed out to the No. 3 zone following completion of the sinking program. Recent work has uncovered the No. 3 zone on surface and sampling has indicated values well above those indicated by diamond drilling.

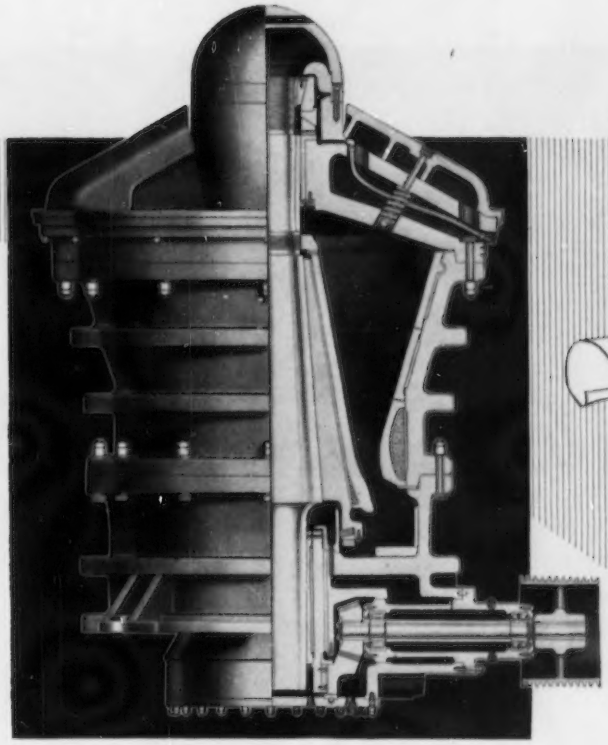
NEW BRUNSWICK

Kennco Explorations Ltd. has indicated some 2-million tons of copper ore in one zone to depth of 550 ft. on its property at Clearwater River approximately 30 miles west of Newcastle. Lead and zinc are also present in the ore. Grade has not been disclosed. Work is now being concentrated on six other zones.

Two zones of massive sulphides, each over 1,000 ft. in length, have been outlined at the property of Anaconda Co. (Canada) Ltd., some 30 miles west of Bathurst. Widths vary from 15 to 115 ft. Five diamond drills are now in operation to test further the copper-lead-zinc-silver indications.

Orchan Uranium Mines has started exploration on two groups of claims in the Bathurst-Newcastle area. A diamond drill has been moved to the 86-claim group adjoining west of Middle River Mining Co., a wholly-owned subsidiary, by geophysical surveys. An electromagnetic survey is being carried out on a second group in the Sevogle River area. This group adjoins the main property of Dobrun Mines and holdings of Kennco Explorations Ltd.

McIntyre Porcupine Mines has taken over the entire holding of Dominion Gulf in various sectors of the province. Some 400 claims in eight separate groups



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For complete information, see your A-C representative or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin, for Bulletin 07B7870. A-4989

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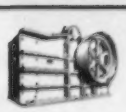
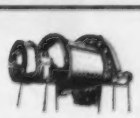
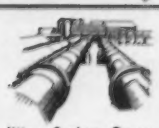

Jaw Crushers

Gyratory Crushers


Grinding Mills


Kilns, Coolers, Dryers

Semi-Automatic Rebuilding of SHEEPSFOOT TAMPERS

A novel idea for salvaging sheepsfoot tampers, with a saving of 45% in cost and 50% in down time, originated with Dave Moodie, master mechanic of J. A. Thompson and Son, large West Coast contracting firm.

As routine maintenance procedure the 220 individual tamper boots on each of the 24 compactors operated by this firm were manually hard-faced until recently in a circle-and-cross pattern; the tamps lasted three or four months before a loss of gauge made them no longer usable. In an eight hour shift the maintenance weldor could manually rebuild and hard-face 18 worn tamps.

Since the firm installed a semi-automatic welder adapted to the use of Stoody 7/64" wires, the picture has altered completely. Today the weldor, using Stoody 121, *rebuilds 70 worn tampers in a single shift!* Mr. Moodie's procedure employs "weld-casting" of the wearing face, using a split carbon mold of the correct finish dimensions. Stoody 121 is applied by the semi-automatic welder, with the mold shaping the large puddle to produce a hard-faced wearing surface of the required depth and gauge.

The rebuilt tampers hold their size twice as long at a considerably lower cost than hard-faced standard replacement boots. Material and labor are approximately $1.25 each for the rebuilt tamper.

You will find many suggestions for prolonging the life of all types of heavy equipment in the Stoody Guidebook. Your Stoody dealer has a copy for you. Look him up in the "Yellow Pages" of your phone book or write direct.

More speed, easier build-up and automatic sizing are obtained by this carbon mold clamped around the sheepsfoot tamper. Stoody 121 wire is applied semi-automatically.

Mold is machined to correct size, grips stem tightly to hold weld metal on wearing surface.

Notice how gauge is still held after 4 months service. Impact strength of Stoody 121 withstands repeated blows of twelve pound sledge used to seat and align tamps during installation.

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New Brunswick *(Continued)*

are included in the deal. First work is to be concentrated on two groups neighboring the Anaconda holdings in the Bathurst area. Diamond drilling is in progress on one of these groups.

QUEBEC

On completion of shaft sinking, Merrill Island Mining Corp. is to start lateral work to test downward extensions of known ore structures at its property in the Chibougamau area. Additional levels are to be opened at 475-, 625-, 775- and 925-ft horizons. Exploratory work in the meantime is being continued on the company's mainland property to the northwest.

Shaft sinking has been started at the copper property of Copper Cliff Consolidated Mining Corp. at Dore Lake in the Chibougamau area. The 3-compartment opening is going down about 650 ft to permit underground exploration of the zone indicated by diamond drilling to contain some 500,000 tons grading 2.2% copper.

Bouzan Mines is pushing exploration work at its copper property adjoining south of Copper Rand Chibougamau in the Chibougamau area. Eight diamond drill rigs are in operation. The program includes cross-sectional drilling and the drilling of two tiers of holes to test the zone at depths of 1,000 and 1,500 ft. Recent drilling has indicated possibility of two additional zones above the main zone.

Diamond drilling has been started on a new asbestos discovery made by Lyndhurst Mining Co. in the northwest sector of its copper producing property, located some 30 miles north of Noranda. A ground geophysical survey, following an aerial magnetometer survey, located a peridotite mass with surface length of 2800 ft. Width averages from 150 to 300 ft. A 1,000-lb bulk sample assayed 3.11% asbestos and graded 4K fibre.

West Macdonald Mines is currently producing 30,000 ton ore from its property near Noranda. Ore is being treated on a toll basis at the Waite Amulet mill some 5½ miles away. Zinc production has been running around 500 to 700 tpm with pyrite output of 18,000 to 19,000 long tons. Zinc output is expected to rise as work in higher grade areas progresses. Property is managed by Noranda Mines, which has a substantial share and loan interest in the company.

Encouraging results are being obtained in drilling at the Chiboug Copper Corp. property in the Chibougamau area. Copper values have been obtained in the favorable Ventures gabbro formation which is believed to be the faulted extension of that in which the adjoining Opemiska Copper has found its ore. Three diamond drill rigs are currently in operation.

B.F.Goodrich

PENNSYLVANIA coal hauler gets 6,000 hours' service from BFG tires.

VIRGINIA miner reports BFG tires can be recapped where others failed.

MINNESOTA iron miner finds BFG tires defy chunks of abrasive rock.

KANSAS miner uses BFG tires to pull 80-ton "hopper cars" out of pits.

These miners save money with BFG tires —here's how you can, too!

A PENNSYLVANIA coal stripper reports B. F. Goodrich Universal tires have given 6,000 hours of service, including recaps. Tire trouble at a Virginia mine used to stop production, run up costs. Then the company switched to BFG tires, now reports their tire problems licked. On a Minnesota ore road or pulling out of a Kansas open pit, B. F. Goodrich tires defy dangerous rock cuts.

These reports are typical of what mine operators all over the country find: B. F. Goodrich tires wear longer and reduce operating costs. Extra-thick tread on the Universal resists cuts and bruises. And under the tread is the B. F. Goodrich *all-nylon* cord body.

Nylon is stronger than ordinary cord materials, withstands double the impact and defies heat blowouts and flex breaks. That's why the B. F. Goodrich *all-nylon* cord body outwears even an extra-thick tread, *can still be recapped over and over.*

Your B. F. Goodrich retailer has a tire for every kind of mine work. Let him show you the one that will wear longer and save you money. Or write *B. F. Goodrich Tire Company, A Division of The B. F. Goodrich Company, Akron 18, Ohio.*

Specify B. F. Goodrich tires when ordering new equipment

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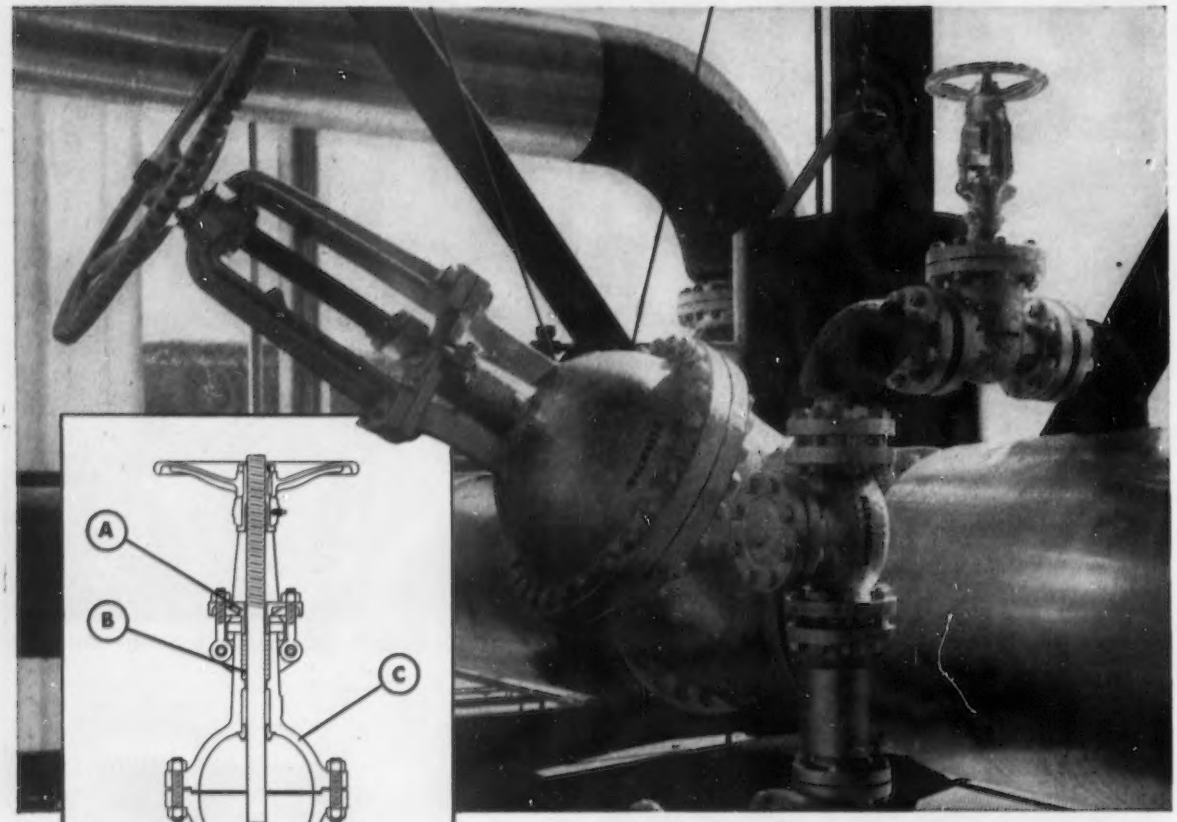
Your B. F. Goodrich retailer is listed under Tires in the Yellow Pages of your phone book



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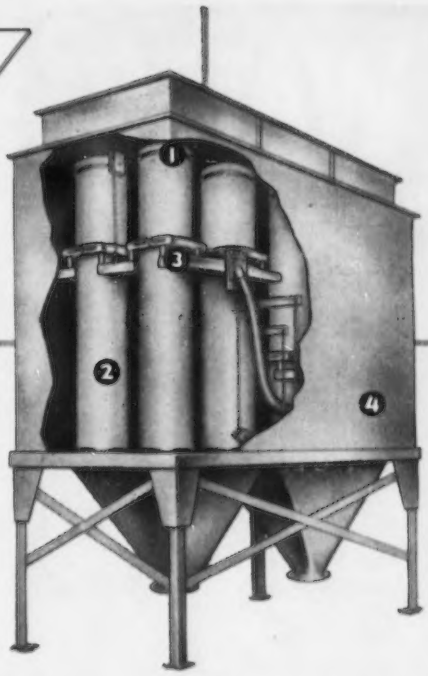
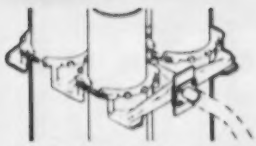
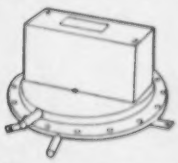
1 Air enters plenum casing at top of Series 12 Aeroturn for equal distribution to all filter bags. Bags are of felt . . . with higher filtering efficiency than woven material. Tiny pores hold even submicronsized dust particles. Cloth area is less than ⅛ that of shaker bags.





3 Self-adjusting blow rings* travel length of filter bag exterior . . . discharge reverse-air-jet into bag which blows accumulated dust off bag walls. Cleaning never interferes with filtering . . . which maintains peak efficiency. Aeroturn remains on the job continuously.

2 The air travels downward through the filter bags, assists delivery of dust into hoppers below . . . escapes through bag walls. Even distribution of dust puts every square inch of the filtering surface to work . . . avoids clogging . . . permits air to escape easily.



4 Automatic pressure switch* controls blow ring operation. Above normal pressure loss automatically actuates blow rings. When pressure loss normalizes, blow rings stop operation. Self-cleaning occurs as often or as little as needed . . . avoids over-cleaning.

Up to 75% Lower Installation Costs—99.9%+ Efficiency with KOPPERS Series 12 Aeroturn Dust Collectors!

Factory-assembled and test-operated, Koppers Model D Aeroturn Dust Collector combines features of Series 12 with unusual compactness. Capacities range from 500 to 4,800 CFM.

50% Lower Maintenance Costs . . . Up to 50% Less Space!

Aeroturn's remarkably high filtering efficiency slashes your plant and machinery maintenance costs further than can any other dust collector. Heating and cooling costs tumble because air can be recirculated . . . cleaner than outside air. Employee and community relations are improved. Yet Koppers Series 12 Aeroturn costs you less to install . . . less to maintain. Space requirements are far smaller.

Operation is continuous and automatic . . . without a drop in peak efficiency due to cleaning. Pre-fabricated Koppers Series 12 Aeroturn ranges in capacity from 1,000 to 60,000 CFM . . . contains from 4 to 64 filter bags each 12″ in diameter and up to 18′ in length.

It takes only a few minutes of your time to discover how Koppers Series 12 Aeroturn may save you thousands of dollars.

AEROTURN DUST COLLECTORS

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Metal Products Division
Industrial Gas Cleaning Dept.

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*Hersey Patents

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Gentlemen: Please send me a free copy of your Aeroturn booklet with descriptions, drawings and photographs. ☐ Series 12 ☐ Model D

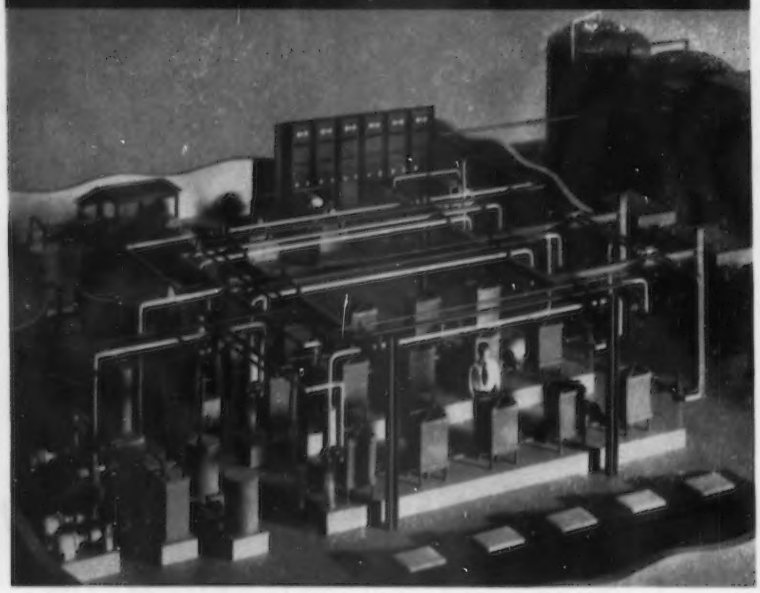
Name..... Title.....

Company.....

Address.....

City..... Zone..... State.....

FRESH WATER
...FROM A BRACKISH WELL



Fifteen months ago, an IONICS electric membrane plant began supplying part of the fresh water required for a drilling and refining community of 5000 people on oil-rich Bahrain Island in the Persian Gulf.

After only five months of operation the purchaser, a major petroleum company, decided to treb le the size of the plant and rely on it completely for the community's needs—abundant proof of the reliability and economy of IONICS equipment.

The expanded plant, shown in this model, is now under construction with special allowance for future increases in capacity.

Specifics on the Bahrain plant:

Well water chemical analysis . . . . . 3100 ppm dissolved solids
Product water chemical analysis . . . . . 450 ppm
Electric energy consumption . . . . . 15 kwh per 1000 gallons
Daily capacity—present . . . . . 28,800 gallons per day
Daily capacity—final . . . . . 86,400 gallons per day

The electric membrane plants remove salt, hardness, alkalinity, gypsum, epsom salts, nitrate and fluoride from natural waters.

They operate continuously, automatically, economically.

They require no steam, no periodic regeneration, and leave no hard scale deposits.

For additional information, write Department M.

IONICS

IONICS, INCORPORATED, 152 SIXTH STREET, CAMBRIDGE 42, MASS.

Quebec *(Continued)*

Purdex Minerals is undertaking a diamond drilling program on its recently acquired 20-claim base metal prospect in Levy Twp., Chibougamau area. The drilling will test anomalies and structures indicated by geophysical surveys and geological work done by the previous owners.

MANITOBA

Dahart Minerals Corp. is carrying out exploration work on beryllium deposits formerly held by Winnipeg River Tin Mines near Greer Lake in the Winnipeg River area.

Mirado Nickel Mines, a recently formed company, has acquired two groups totalling 72 claims in the Reed Lake area. A diamond drilling program is underway to explore a nickel-copper showing where preliminary samples ran 3% to 5% combined nickel copper.

Cove Uranium Mines has commenced drilling on its 650-acre lithium property in the Bernic Lake area. The ground adjoins Montgarry Explorations to the south.

The company has also made plans to carry out surface work on a 98-claim nickel-copper prospect in the Cuthbert Lake area, approximately 25 miles southeast of the Mystery Lake nickel belt.

Springhurst Copper Mines reports a program of diamond drilling is being carried out on its 29-claim group adjoining the North Star Mine of Hudson Bay Mining & Smelting. Previous drilling indicated a zone over 30 ft. in width carrying copper-zinc values.

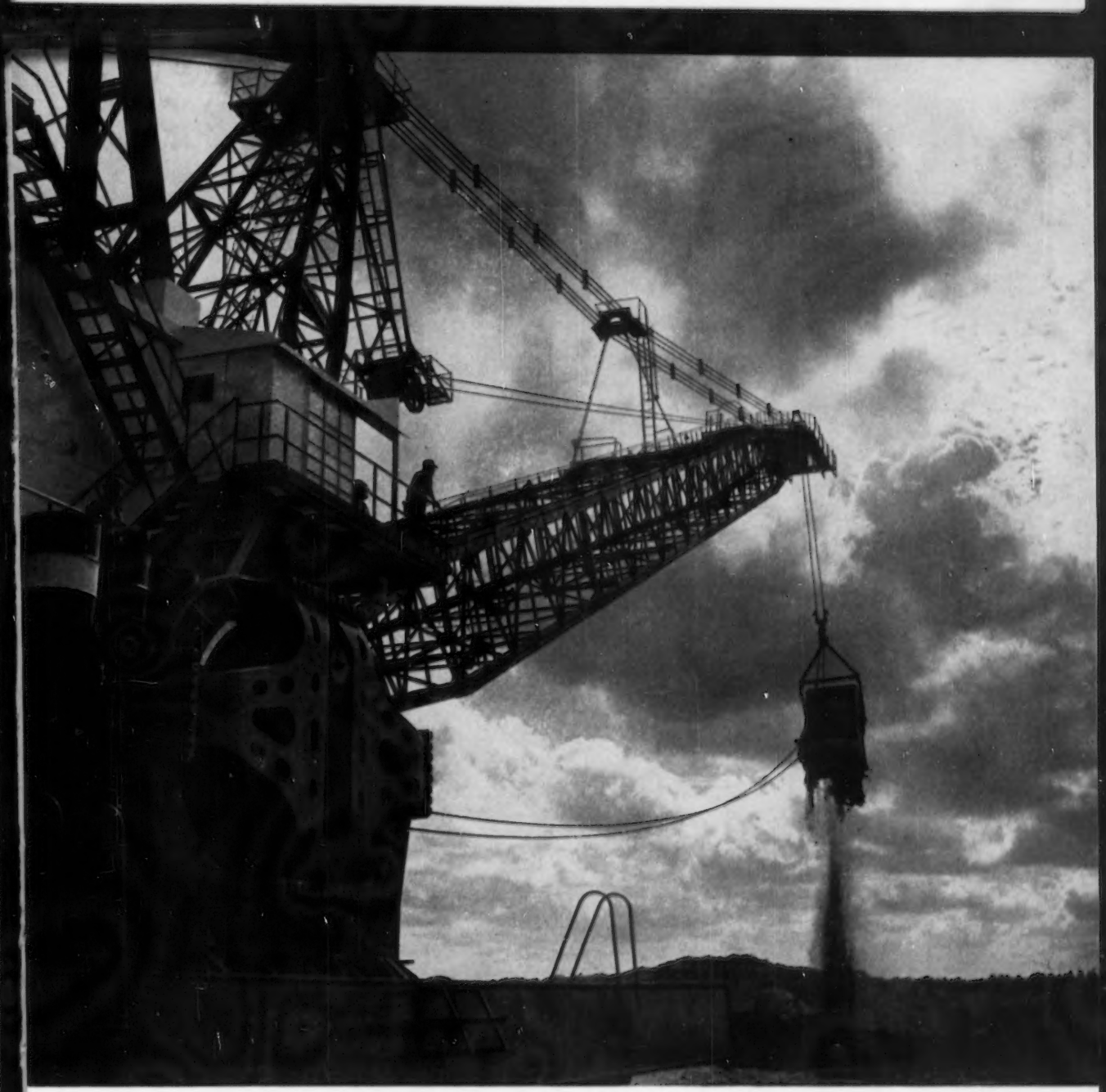
Nor-Acme Gold Mines has let a contract to drill the Deb group of claims in the Flin Flon area. The program is based on results of a geochemical survey over the area.

Tern Lake Mines, owned jointly by Northern Canada and Pioneer Gold, is commencing an electro-magnetic survey of its holdings in the Snow Lake area.

Combined Developments reports 5,869,000 tons of ore averaging 1.2% lithium oxide is indicated on its Herb Lake property. Negotiations are underway to finance development of this property. The company has also acquired a copper prospect in the central Manitoba area.

Sherritt Gordon Mines is proceeding with construction of a second power plant on the Laurie River which will double the supply of power for the Lynn Lake Mine. Operations are to be expanded by increased tonnage with ore grade brought down to mine average. It is planned to produce 20-million lb. of nickel a year without mining an undue proportion of the higher grade ore in the EL mine.

Lee Gordon Mines is resuming drilling on its copper prospect at Vamp Lake approximately 32 miles east of Flin Flon.



Wire Rope at Work—This monster, which looks like a cross between a battleship and a dragon, can scoop up 22 yd of earth at a single pull of the bucket. Its insatiable appetite for rock and dirt is its greatest asset, especially in stripping large areas where the overburden is thick.

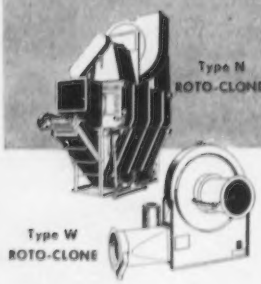
The huge excavator would get nowhere, of course, without the wire ropes that drag and hoist the bucket. On this job, Bethlehem Purple Strand was used for both applications—2¼-in. 6x25 for the draglines, 1¼-in. 6x41 for the hoist lines. Whopping big cables, particularly the drag ropes; even in the roughest kind of going, they put "hustle" in the job. Ropes like these can move that bucket all day long and still be ready for more.

Bethlehem Steel Company, Bethlehem, Pa. On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

Mill depots and distributors from coast to coast stock Bethlehem rope for the following industries and numerous others:

MINING • QUARRYING • CONSTRUCTION • EXCAVATING • PETROLEUM • LOGGING • MANUFACTURING

How AAF Licked the TACONITE Dust Problem



Wet-collecting ROTO-CLONES serve all major taconite processors

TACONITE dust was something special. Many particles were of microscopic size . . . *all* were extremely abrasive . . . dust loadings were unusually heavy. That's why the pioneer taconite processors took the challenge to AAF.

Two rough-and-ready ROTO-CLONES—the Type N and the Type W—were first assigned the tough cleanup job on this vital ore in 1947. They've been performing effectively and inexpensively ever since, and are now used by *all* major taconite processors.

The Type N combines centrifugal force with the thorough intermixing of water and dust-laden air. The Type W combines dynamic precipitation with dust-trapping water sprays. *Both* offer (1) small space requirements, (2) maintained performance, (3) constant exhaust volume, and (4) high collection efficiency.

Whatever your dust problem, take a tip from taconite—call your nearest AAF representative or write direct for Type N Bulletin 277 and Type W Bulletin 274.

AAF American Air Filter COMPANY, INC.
195 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal, P. Q.

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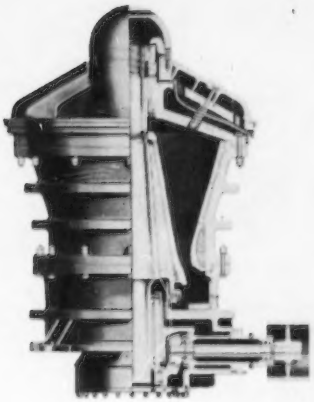
TISCO MANGANESE STEEL

helps ALLIS-CHALMERS CRUSHERS

give more for less cost



Superior* Gyratory Crushers are unsurpassed for tonnage and operating economy. Tops in engineering, workmanship and materials, these hard-working Crushers stand up to their tough job day in and day out with a minimum of maintenance.

Head mantles, concaves and like products made of TISCO Manganese Steel, are most resistant of all materials to impact and abrasion. Under such conditions of wear, TISCO Manganese Steel develops an extremely hard, long-wearing surface. This assures maximum production with minimum downtime for replacement.

First to produce 12-14% Manganese Steel, Taylor-Wharton leads the field in producing new and special alloys which are designed to fit your operating requirements. These alloys range from hard abrasion resistant TISCO #150-Y high Chrome alloy to the more ductile types which have been developed to combat impact and abrasion.

There is a TISCO alloy steel to suit your needs.

We would be glad to have a Taylor-Wharton Sales Engineer call on you at your request.

*Reg. U.S. Pat. Off. by Allis-Chalmers Manufacturing Company

Use TIMANG Weld Rods and Shapes for rebuilding and repairing worn parts made of manganese steel.

TW

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DIVISION OF HARSCO CORPORATION

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These are terms that JKS engineers are concerned with 24 hours a day in the design and manufacture of Diamond Drill Bits that suit your coring and drilling qualifications to a "T".

Throughout years of steady progress these standards were the basis for the drilling bits that are now recognized as unbeatable the world over.

HARDHED matrix for non-abrasive formations
HARDHED 40 matrix for average drilling conditions
HARDHED 55 matrix for extremely abrasive formations

When you next need a diamond drill bit which no formation will slow up, gives full core recovery, faster penetration *AND* saves you *days* and *dollars* in coring and drilling, contact your nearest J. K. Smit field representative or write us direct for literature and assistance.

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HOME OFFICE AND PLANT
MURRAY HILL NEW JERSEY
Additional plants in London, Paris, Amsterdam and Toronto, Canada

Manitoba *(Continued)*

The property, consisting of 21 claims, was previously drilled in 1948-49.

BRITISH COLUMBIA

A million dollars changed hands when H. H. Huestis and his three associates closed a deal with Climax Molybdenum Co. for sale of their 103-claim molybdenum property near Lac La Hache in the Cariboo country. Huestis, one of B.C.'s most fabulous mining characters, and partners Pat Reynolds, John A. and William McLallen turned an original $10,000 investment three years ago into the million dollar sale.

Climax Molybdenum had been looking for another commercial property for some time and recently established an office in Vancouver, under the direction of Art Hall. Thomas E. Congdon, financial manager of Climax's western operations and S. Kitchen, attorney, both of Denver, closed the deal with Huestis and his partners. The million dollars is payable over a period of five years.

Kaslo Base Metals Ltd., at Ainsworth is now controlled by Red Hawk Gold Mines Ltd. who bought share control and management of the property. Red Hawk is putting the silver-lead-zinc mine into production immediately. Dr. A. G. Pentland, consulting geologist, has joined the board of Red Hawk; Fred J. Hamsworth has been appointed consultant.

Hemsworth inspected the property last June and reported a probable 15,000 tons of ore in the east and west veins. Possible ore, he said, should be several times that figure. Average grade per ton is 2.2 oz. silver, 6.9% lead and 4.1% zinc, Hemsworth reported. Last report from Kaslo officials said an unfinished drift of approximately 335 ft would be completed to get under the proven orebody.

National Explorations Ltd. and its associates acquired nickel-copper property in northern Saskatchewan from the original stakers, George A. Bleiler and Frederick A. Giauque, of Uranium City. National described it as of "apparent major importance."

Claims are in the pre-Cambrian shield, about 100 miles east of Beaverlodge Lake. Surface showings occur over 2½ miles. Engineers from Vancouver and the East have left for the property and they are expected to map a program of diamond drilling to explore the depth of ore occurrence.

Cronin Babin has resumed mining and milling at its silver-lead-zinc property near Smithers. The renovated mill is currently handling 40 tpd ore and company officials say the present output is averaging 5 tons of lead concentrates and 5 tons of zinc concentrates daily.

Canam Copper Co. Ltd., will build a minimum 1,000-ton mill at its Manning Park property near Hope. Construction will start next year. Footings for a 2500-ton mill are being put in with an eye to

EXTRA-TOUGH going calls for extra-tough AMSCO® DIPPERS...with Renewable Lip

On the Iron Range and in the Copper Mines, demands on dippers are really tough. And that's where Amsco Manganese Steel Dippers have proved they can "take it"...in years of rough use.

Amsco *Renewable Lip* Dippers are particular favorites here. For when the lip eventually wears out, this easily changed unit cuts "repair-time" to *one-tenth* that required for change-over of conventional designs.

The lip sides overlap and fit snugly into sockets in the back casting. Lugs on lip fit into slots in front casting and are secured by forged, split keys. Sturdy U-bolts fasten lip to back casting, pulling it tightly to dipper when double nuts are screwed down. The result is one-piece rigidity and strength, free of play in any direction.

You save two ways: first, through the extra-long service life of Amsco Manganese Steel Dippers; second, through quick and easy replacement of the Renewable Lip.

See your shovel manufacturer for full information on Amsco Dippers, or write us direct.

AMERICAN Brake Shoe COMPANY

AMSCO

American Manganese Steel Division • Chicago Heights, Ill.

OTHER PLANTS IN: DENVER, LOS ANGELES, NEW CASTLE, DELAWARE, OAKLAND, ST. LOUIS, JOLIETTE, QUEBEC

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Give your TRUCKS this 9-way test...

IT'S COSTING YOU MONEY *NOT* to have these Autocar extras that mean so much on tough truck operations. Why not investigate AUTOCAR now. It's today's greatest truck quality . . . your best truck value!

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that means lower maintenance cost, longer truck life—no matter how tough the going, how big the payloads.

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. . . about soda ash service beyond the product itself

If you have ordered West End soda ash you are sure of top quality . . . but that is only the beginning of West End service. Your requests in matters of routing, scheduling, invoicing and advices are both invited and encouraged. They are attended to promptly and cheerfully. Feel free to make requests . . . no matter how small . . . at any time.

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EXECUTIVE OFFICES, 1956 WEBSTER, OAKLAND 12, CALIFORNIA • PLANT, WESTEND, CALIFORNIA

720 TONS . . . AN HOUR'S HAUL WITH THIS SAUERMAN TOWER EXCAVATOR

Pioneer's giant excavator is the largest power scraper installation in the sand and gravel industry.

Pioneer Sand and Gravel Co., Seattle, Wash., needs a huge flow of material to supply its ready-mix plants and barges. They're getting it with a 12-cu. yd. Crescent Scraper.

The Crescent handles 480 yds. or 720 tons per hr. over an average haul from 300 to 350 ft. It operates along a 675-ft. span between movable head and tail towers located at the base and top of the 240-ft. high bank.

In addition to high rate of delivery, adoption of the Sauerman Method provides two other advantages over the 5-cu. yd. power shovel that formerly operated off the "toe" of the bank. These are: (1) material can now be taken from anywhere on the bank for blending and selection of gravel, and (2) material can be moved down the slope with no danger of cave-ins.

The tower excavator at Pioneer is mounted on portable towers and engineered by Sauerman for economical excavation in this type of deposit. This same digging tool . . . the Crescent scraper . . . can be engineered to your operation to give you equivalent high production at low cost.

Sauerman Scrapers range from ½ cu. yds. up to 18 cu. yds.

Because in most cases it is cheaper to drag material than it is to lift and transport it, *they give you the lowest cost per cu. yd. handled.*

Contact us for information and specific recommendations. Ask for field reports and Catalog A.

This view gives some conception of the height and steepness of the bank on which the Crescent works.

The Crescent delivers to a portable field hopper from which belt conveyors transport the material to the plant.

SAUERMAN BROS. INC.

626 S. 28th AVE. BELLWOOD, ILL.

Crescent Scrapers • Slackline and Tautline Cableways • Durolite Blocks

British Columbia *(Continued)*

the future.

Ore reserves are estimated at 3¼-million tons, averaging out at 1.44% copper, 0.02 oz gold and 1 oz silver.

Giant Mascot Mines estimates its new lead ore discovery to be "at least 500,000 tons" and perhaps three times as much as that. They recently diamond drilled property at Spillimacheen.

The company is now mining in the first orebody of the major find and there will be a tunnel into the second soon. Past mining operations show ore persists for 1,000 ft. from surface.

A new B. C. company formed to explore and develop a limonite deposit three miles from Tauw Lake, 39 miles east of Terrace, is called Shawana Iron Mines, Ltd. The company has acquired five Crown granted claims covering some 200 acres. Engineers estimate 7.5-million tons of ore at the property.

Nicolas Mussallem is president of the company and Michael Hretchka is managing director. Directors are Arnold Enge, H. A. Strubin and John R. Browne.

Search for the legendary Lost Creek Mine, believed to be in the Pitt Lake area about 36 miles from Vancouver, has been started by the newly formed Pitt Lake Mines, Ltd.

Legend says the mine is fabulously rich in gold and 21 fortune hunters are reported to have lost their lives trying to find the yellow metal. Vancouver businessman, prospector John Cotowick, president of the company is going in prepared for the rugged country with 15 men, a bulldozer and diamond drilling equipment to explore 32 claims in the area.

New Copper discoveries have been reported on Vancouver Island by Nadira and Cowichan. Nadira's find is in the Nitanat area. The sulphides occur cross 14 ft and are estimated to average from 4 to 6% copper. Assays average the Cowichan copper hit at 2.25%. It is in their lake property at the 110-ft level.

The companies are two of the half dozen headed by O. G. MacDonald to explore his 700 claims in the island's belt of volcanics.

A special stockholders' meeting approved a 5-1 consolidation of share capital for Canusa Cariboo and changed corporate name to Canusa Mines, Ltd. New company will have 3-million authorized no par shares of which 377,044 shares will be issued to cover share conversion.

Stockholders also okayed directors' decision to acquire a new silver-copper property near Smithers.

YUKON

Macken Mines Ltd. at Keno Hill, Yukon, reports underground development work continues to open up new ore at a rate in excess of that at which the mill is operating. On the new fifth level ore

Consolidated Copper's new high-speed team—
large drill, big shovel, off-road truck and
mobile 27 mph MICHIGAN TRACTOR DOZER

Take a good look at the picture above. If you were at Consolidated Copper Corporation's Tripp Pit at Kimberley, Nevada, this would be about the only time you'd see their high-speed Michigan Tractor-Dozer at a standstill. And, even here, it won't be for long . . .

Michigan Tractor-Dozer's turbo-charged diesel develops 165 hp, with maximum rimpull of 28,000 lbs. Blade capacity is 2¾ yards. Powered bowl tilt and down-pressure are standard. Unit, shown here, is dozing boulders at Consolidated Copper's pit near Ely, Nevada.

Seconds after the truck leaves this waste-stripping bench, the Michigan will slip in to clean the load area. Instant, shock-free, no-clutch, finger-tip shifting between forward and reverse moves the Michigan quickly out of the way of the next truck or the shovel boom. Operator has utmost safety because he keeps foot on accelerator at all times. Visibility is excellent all-around. Power-boosting makes steering easy.

Goes anywhere at 27 mph

After the Michigan finishes cleanup here, its next call may be to another shovel, to the dump, or to clear debris from the haul road. Wherever the call, it gets there about as fast as the trucks. Top speed of 27 mph takes it half a mile, across tracks, hard-surfaced roads and trails in 1 to 2 minutes. Oscillating steering axle keeps both rear wheels in firm contact with the ground at all times. With 14½ inches of clearance, operator practically never gets hung up. And rear-wheel steering greatly reduces tire wear.

See it in action

The best way to analyze the advantages of 27 mph speed, power-shifting, and full-time four-wheel traction is to do what Consolidated Copper did—*test* a Michigan Tractor-Dozer, with your own operators, in your own pit. You pick the work . . . then time cycles, measure output, compare price per yard of dozing capacity (don't forget Michigan's f.o.b. price includes power-shift transmission, 3-to-1 torque converter, planetary wheel axles, and power-tilt blade . . . you don't have to pay for "extras" to get top efficiency).

Michigan is a registered trade-mark of

CLARK EQUIPMENT COMPANY
Construction Machinery Division
2465 Pipestone Road
Benton Harbor 47, Michigan

CLARK® EQUIPMENT

Yukon *(Continued)*

has been entered by crosscutting at 25-ft, indicating new ore tonnage in a large block of ground between the fifth and fourth levels that can now be added to ore reserve.

IN LATIN AMERICA

BOLIVIA

A reorganization of the Bolivian Mining Corp. (Corporacion Minera de Bolivia) as recommended by Ford, Bacon and Davis, U. S. consultants, has taken place. The agency, which has managed the country's tin mines since their nationalization four years ago, is now an autonomous institution, according to the Supreme Decree which outlined the revamping.

The new seven-man board is made up of representatives of the Bolivian President, cabinet, comptroller and organized labor. Raul Gutierrez Granier is the new president of the board.

The Hormet copper plant will soon expand installations by importing foreign machinery at a cost of $54,000.

Two German heavy machinery experts are coming to Bolivia "in order to study field conditions and advise on the proper use of machinery."

They are technicians from Demag, German manufacturers of heavy equipment for mines and petroleum, and are coming as a result of talks carried out in West Germany by Bolivian representatives.

The German mission, composed by a geologist and an engineer, will study:

- Mineral fields and concrete projects of exploitation.
- Technical cooperation for the acquisition of equipment and machinery for mining exploitation.
- The work and condition of their machinery on projects in Bolivia.
- The possibility of giving Bolivia 2- to 4-year credits.

CHILE

Drilling at the Mantos Blancos copper deposit some 30 miles east of the port of Antofagasta by Sr. Mauricio Hoschchild's interests continues satisfactorily. Atacamite, the oxychloride of copper, accounts for about 60% of the copper values found, presenting some metallurgical difficulties in finding the most suitable method of treatment. The high percentage of chlorine in the ore precludes the use of electrolytic winning for the copper. To find the best method of reduction, a 10-ton pilot plant has been built at Antofagasta where ion exchange has been

Allis-Chalmers Pumps Solve a Quarrying Problem

Jetting Silica calls for Constant High Pressure

And, for 10 years, Allis-Chalmers pumps at Ottawa Silica Company, Ottawa, Illinois, have been delivering the pressure needed to disintegrate sandstone and carry the resulting silica to hydraulic intake lines.

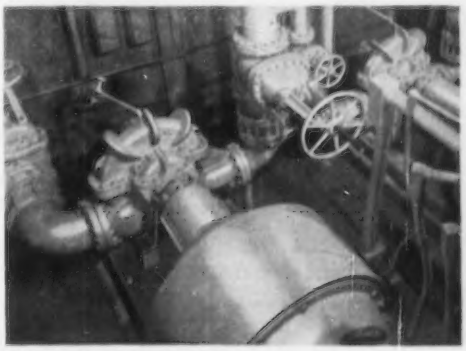
To meet a wide range of capacities, three double volute pumps are used. They insure freedom from shaft deflection under light loads. These pumps are rated at 3000 gpm against a 450-ft head, delivering nozzle pressures as high as 180 psi.

Ottawa Silica Company also selected Allis-Chalmers pumps for boiler feed, condenser auxiliary, process water, fine sand reclamation and pit-seepage water level control. Other Allis-Chalmers equipment at the Ottawa plant includes turbines, vibrating screens, motors and controls.

You Get MORE than a Pump . . . When You Specify Allis-Chalmers

You get the advantage of Allis-Chalmers wide experience in supplying pumps to all industries. You are assured of modern design, heavy duty construction and correct application aid—resulting in added years of dependable day-after-day pump service.

Allis-Chalmers is the only company that can offer you "One-Source" responsibility for a complete unit — pump, motor and control — all built to work together. For "MORE" information, call your local A-C office or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.



Three of these Allis-Chalmers pumps furnish the water used in the jetting process at Ottawa Silica Company. They are powered by Allis-Chalmers synchronous motors rated at 500 hp, 2300 volts, 1800 rpm.

A-C ALLIS-CHALMERS

A-5117

One of the many drill rigs now in operation throughout the United States and overseas.

The most important primary phase of construction, roadbuilding or mining begins with foundation investigation or exploratory work from which it is desired to get complete information and best possible cores. In many instances, contractors make the mistake of bidding on work or taking a contract without complete knowledge of sub-surface conditions, or miners will start mining operations without first conducting a thorough exploration program, but successful contractors and mining men always investigate first to know how to quote in order to get the contract and still make a profit, and how to plan to have a successful operation. One of the most reliable organizations in America for furnishing this information and satisfactory cores is Sprague & Henwood, Inc. For more than seventy years it has been rendering satisfactory core drilling service throughout the United States and the world. Many of its customers have continuing contracts with Sprague & Henwood, Inc., because they know that they can be assured of the best in foundation investigation and core drilling service that can be found anywhere.

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Chile *(Continued)*

tried out. Sulphide copper minerals have not been found in commercial quantities.

Small and medium size iron mines exported last year 616,000 metric tons of high grade iron ores; this year, exports are expected to reach 1.2-million tons and it is hoped that by 1957 this class of mining, absolutely underdeveloped 4 years ago, may reach 3-million tons of exportable high grade iron ore, over 60% metallic iron. Chile's biggest iron deposit, Algarrobo, which has about 100-million tons of 60% iron ore and belongs to a Dutch-German concern is still unworked. Algarrobo is located to the southwest of the town of Vallenar and the ore could be shipped through the port of Huasco or through Cruz Grande which was the loading port for Bethlehem El Tofo iron mine, now worked out.

Huachipato, Chile's steel mill is producing at the rate of 360,000 metric tons of steel ingots per year. By 1960 ingot output should reach 430,000 yearly, enough to supply the needs of the country and to leave a small surplus for export.

The Paipote Copper Smelter has been such a success, that the National Smelters Corp. has decided to double its capacity to 260,000 metric tons of charge a year. A new 450-tpd reverberatory will be built and a new large converter will be installed. The power plant will also be increased to 5,000 kw. The cost of the new installations have been estimated at $2-million (50-million pesos).

A new government agency which will be called National Society of Radioactive Materials has just been formed by the Mining Credit Bank, CORFO, National Smelters Corp. and the Army's Ordnance. This new agency will start work with a capital of 120-million pesos and proposes to build a plant to produce uranium concentrates as a first step in its development.

IN THE PHILIPPINES

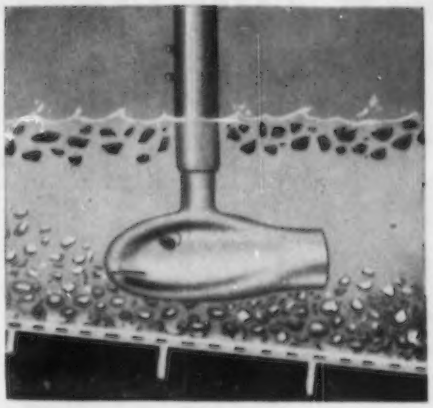
Benguet Consolidated Mining Co., oldest and most important gold producer in the Philippines, has been reorganized and reincorporated under Philippine laws. The name has been changed to Benguet Consolidated, Inc. It is proposed to merge Balatoc Mining Co. into the new company which would result in substantial savings for both concerns. Ralph Crosby will continue as general manager of both mines.

A 300-ton mill has been proposed at Suyoc to produce gold bullion and copper concentrates. Estimated reserves at the outbreak of the war in 1941 were 280,000 tons averaging $15.50 per ton. The property has lain idle ever since.

A second 80-ton unit in the reduction plant of the Palawan Quicksilver Mines

Jigging stratifies materials according to specific gravity, separating solids in upward and downward pulsations of water. The heavier materials settle to the screen plate and are drawn off. The lighter materials overflow.

Jigging is an almost universal separating process for materials ranging from the specific gravity of gold at 19 to coal at 1.3. Proportions of the high-gravity materials may vary from 90% to 10% or less.



jig recoveries compare favorably with float-and-sink (heavy liquid) recoveries on Mesabi iron ores

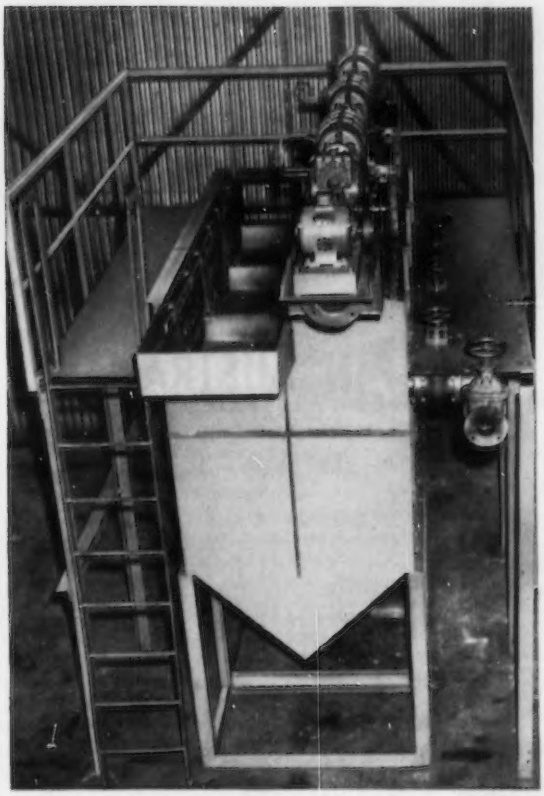


Illustration shows Jeffrey all-hutching jig in which high-gravity materials are withdrawn through perforations in the screen plate. Other models are also available.

	Ore	FLOAT-AND-SINK		JIG	
		Fe, %	Recovery, %*	Fe, %	Recovery, %
All Sizes 1″ x 0″	"A"	58.8	96.4	56.79	88.5
	"B"	59.9	95.3	59.53	82.7
	"C"	57.9	92.3	57.80	82.6
	Av.	58.9	94.7	58.04	84.6
+65 Mesh for F-&-S and +48 Mesh for Jig	"A"	58.8	94.8	57.83	90.7
	"B"	59.9	89.8	60.71	93.8
	"C"	57.9	89.7	58.83	88.4
	Av.	58.9	91.4	59.12	91.0

*All minus 65-mesh iron considered recoverable.

In the above tabulation, recoveries by jigging to 48 mesh are compared with possible recovery shown by float-and-sink to 65 mesh. The average figures show that the jig recovery in the + 48-mesh sizes is the same as that shown by float-and-sink down to 65 mesh.

Complete technical data on these tests will be furnished upon request. Write to The Jeffrey Manufacturing Company, Columbus 16, Ohio.

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AUSTRALIAN MINERAL SANDS are tested in the desolate dune area of Stradbroke Island, Queensland, in the Titanium & Zirconium Industries Pty. Ltd. operations there. Zinc Corporation Ltd. owns a major interest in T&Z.

Philippines *(Continued)*

has begun operations. Production of the combined units during July totalled 278 flasks, valued about $72,000.

A new copper producer made its initial shipment in August to Japan from Samar. Known as the Bagacay operation, the property is controlled by Elizalde & Co. and Cabarrus Bros. of Manila. The first shipment of ore of 2,000 tons was reported to average 12% copper.

Another merger has been announced of three associate companies, Itogon, Suyoc Consolidated and Palidan Suyoc Deep Level Tunnel Co., all located in the Baguio area. It is proposed to enlarge the Itogon mill and rebuild the Suyoc mill. Itogon has been a gold producer for over 20 years. Reserves as of June 1, 1956 are stated to be 693,000 tons averaging $10.14 per ton. Present mill capacity is 500 tpd. It is planned to increase this to 650 tpd at a cost about $240,000.

IN AUSTRALIA

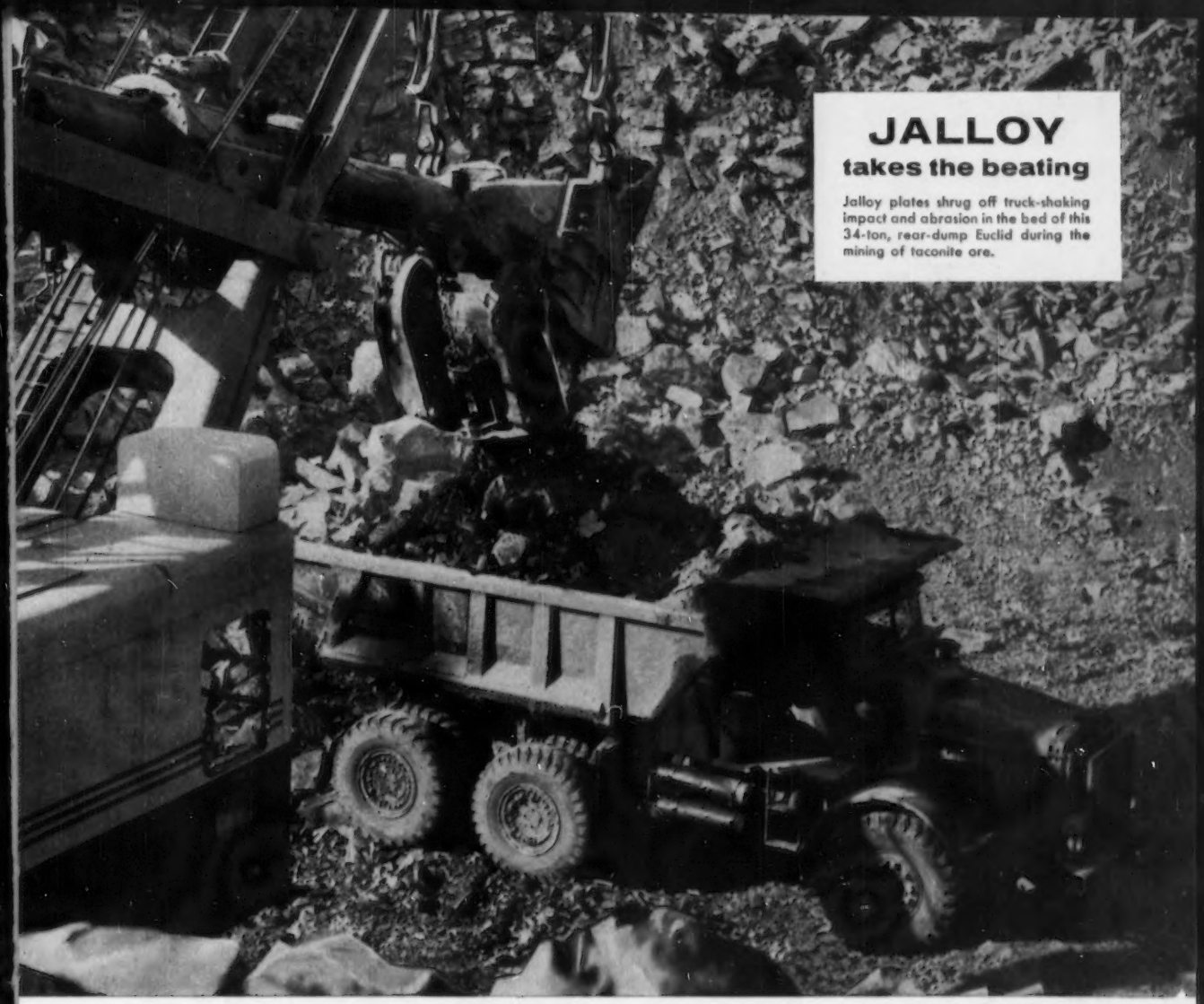
Official Australian export figures for the fiscal year ended June 30, 1956, disclose that most of Australian production of rutile and zircon concentrates was exported to the U. S.

Australian exports of zircon concentrate hit 1,103,007 cwt valued at £A622,-034; 52% of this volume was exported to the U. S. and only 20% to the U. K.

Exports of rutile concentrates amounted to 1,395,970 cwt valued at £A4,628,141. The U. S. took 44.5%.

The entire Australian exports of tantalum and columbium ores and concentrates went to U. S.; 826 cwt were exported with an f.o.b. value of £A87,021; 2,623 cwt of tin ores and conventrates were exported for £A77,720 and practically all of it went to the U. S.

American experts have been asked to examine the Nowa Nowa iron ore deposits in Victoria, Australia and some of the biggest U. S. mining corporations are



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Jalloy plates shrug off truck-shaking impact and abrasion in the bed of this 34-ton, rear-dump Euclid during the mining of taconite ore.

Jalloy heat treated steels . . .
cut maintenance—give longer wear life

Jalloy—special purpose steels that are heat treated to provide longer wear on applications where impact and abrasive conditions are severe—last 4 to 20 times longer than conventional mild steels. Furthermore, they are easily welded.

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No. 7—possesses high hardness together with good ductility or wear resistance. Excellent for spring applications as well as flat work.

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J&L STEEL

Australia *(Continued)*

other deposits in the South Alligator area.

Copper assaying 8% has been discovered

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Macks keep shovels on the go because they make fast hauls between mine or quarry and unloading site. They can be depended upon to meet schedules because Macks don't bog down or break down when the going gets tough. They handle the heaviest loads under the toughest conditions. They require minimum maintenance and provide maximum fuel economy.

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Added dependability for materials handling equipment . .

Africa *(Continued)*

has come to a halt. The high values found

Australia *(Continued)*

reported to be interested. The deposits have been subjected to preliminary examination only but these proved them to be very promising. The Victorian Cabinet may advertise for world-wide tenders for developing the Nowa Nowa field.

A uranium content of 4% was disclosed in samples from the recently discovered uranium deposits at Rossarden in the north-eastern part of Tasmania. South Australian Mines Dept. experts believe that the ore won't require an expensive treatment plant and the area will be diamond drilled in the near future.

Western Uranium Mines N.L. expects its production of copper concentrates to start early in 1957. Further progress has been made in the construction of the plant and the rise in price of copper makes the project more profitable.

A large sale of pitchblende completed by Uranium Mines N.L. and Norther Uranium Development N.L. has resulted in a $1.2-million profit and it is estimated that the mine still retains uranium-bearing ore worth about $7-million.

A sale contract for uranium oxide at satisfactory price is assured if sufficient ore could be developed by the end of 1957 to warant installation of a treatment plant. If the plant is not erected, mining will proceed at El Sharana, Palette and other deposits in the South Alligator area.

Ore will be shipped to Rum Jungle treatment plant. Ore reserves of about 80,000 tons assaying 0.5% have been established at El Sharana, and assays averaging 4.03% uranium oxide have been recently reported at the 80-ft level at El Sharana. Preliminary examination of the Saddle Ridge lode leads to a conclusion that this, too, could yield payable uranium ore. In the meantime, hand-picking of pitchblende from tope ore is continuing.

The Queensland copper and gold producer, Mt. Morgan Ltd., had a sharp fall in earnings. Net profit dropped by £A102,787 to £581,533. Dividend payment is reduced from 2s6d to 2s per share.

Copper assaying 8% has been discovered in the No. 7 drillhole on the Golden 40 lease jointly owned by Kia Ora Gold Corp. N.L. and Australian Development N.L. The copper orebody was intersected between 389 and 456 ft with an estimated true width of 50 ft.

IN AFRICA

No payable values were found in underground exploratory work done by the Venterspost Gold Mining Co. for the Middelvlei Co. on its property in the Randfontein district, and the prospecting

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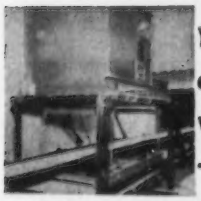

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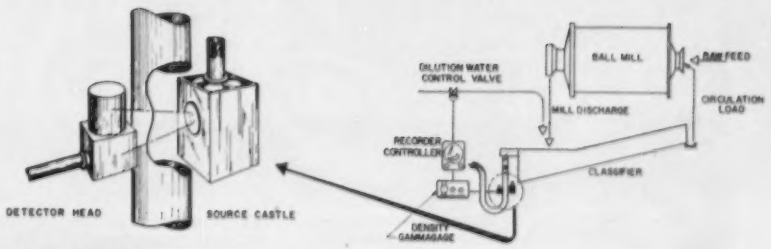

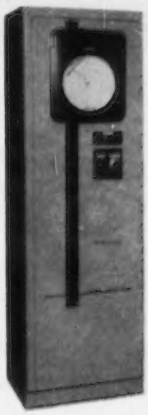

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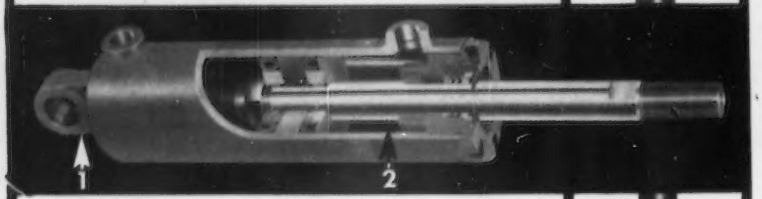

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Africa *(Continued)*

has come to a halt. The high values found were 40 in-dwts, and others ranged down to 3.

Middlevlei is also doing exploration to the east of the farm 28 plot, hopes that massive reef formations exist there. The work should necessitate methods—such as block caving—never before used in South Africa.

Gold mining operations ceased at Nigel's property due to working losses and poor values in the remaining reserves, and Modderfontain B Gold Mines announced that they, too, would end mining operations late last month. The Modderfontain shut-down is the third in three months, has worried the South African Government, which is trying to find a way of helping the low-grade gold mines. They estimate 14 properties are operating with working profit of less than 35c per ton milled, that the total output of these mines is large and vital to local foreign exchange resources.

An Aerofall mill will be used for the first time in southern Africa metal mining in the new Sineis Copper Mine that Messina Development Co. is opening in Southern Rhodesia. The operation is expected to mill 75,000 tpm ore at 1.66% copper turning out 10,000 long tons of the metal a year. This top capacity is due by 1959.

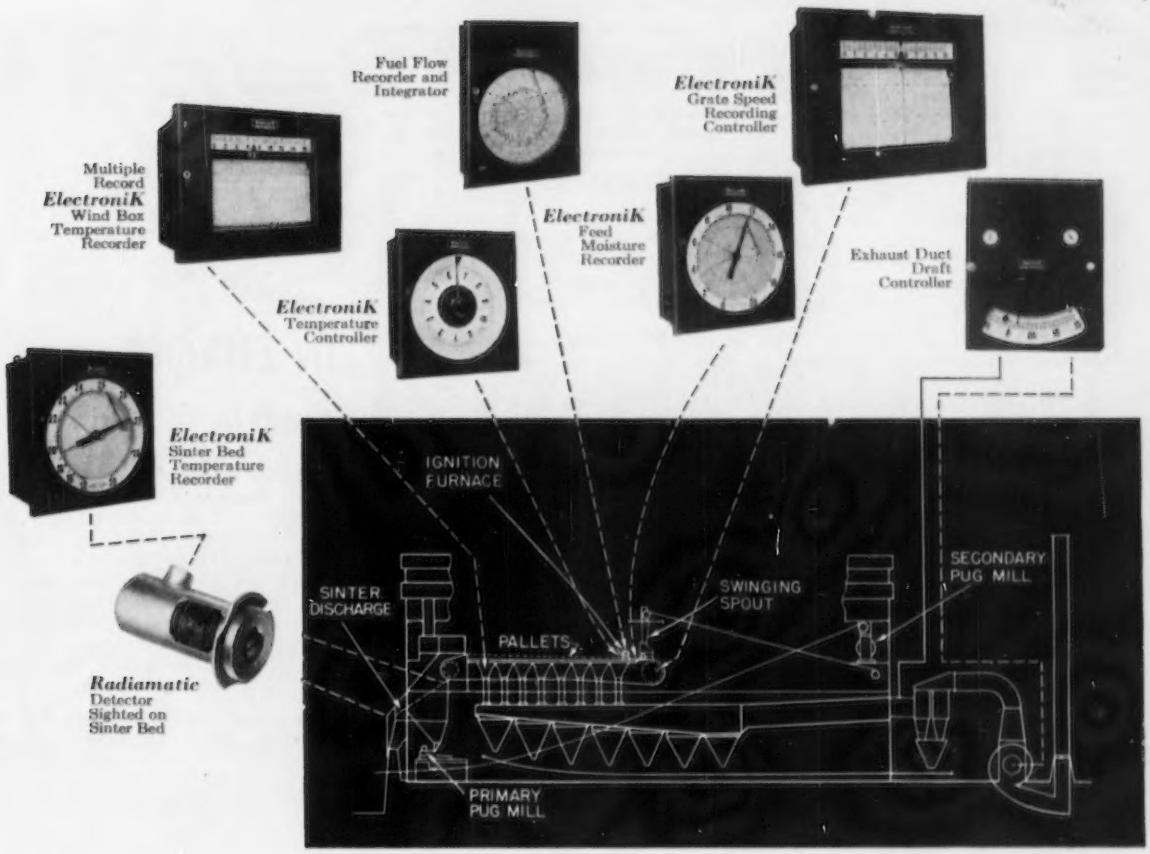
Two major South African mining finance houses are planning to combine. Central Mining & Investment Corp. and Consolidated Gold Fields Ltd. will merge to form the second most powerful mining finance group in the country—Sir Ernest Oppenheimer's Anglo-American is still the giant—and control 21 mines at present turning out more than half of South Africa's gold production. Reasoning behind the merger: Central's property has passed its peak, but the company has large liquid resources looking for investment, Consolidated has new mines and areas under exploration, but is somewhat short of cash.

Government of Southern Rhodesia says that 19 areas covering about 1,000 sq miles are now under examination by major mining companies. Exclusive prospecting rights are held in Southern Rhodesia by the following groups operating either directly or through subsidiary companies: Rhodesian Selection Trust Exploration Ltd., Rio Tinto, Anglo American Corp. of South Africa and Messina Transvaal Development Corp. Ltd.

The government, in granting exclusive prospecting rights, required the companies to undertake to spend at least $850,000 in the areas.

W. Ralston, chief government mining engineer, has said that the majority of the prospectors are interested in chrome, copper, zinc, lead, nickel and lithium, strikes of which have been reported during the past six months.

The latest award of an exclusive prospecting reservation over a 23-sq mile area has been given to Rhodesian Selection Trust Exploration Ltd. The area lies between the Sabi River and the Odzi. The application refers to a search for tungsten.



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BROWN INSTRUMENTS

First in Controls

Africa *(Continued)*

Radioactive sands containing thorium and uranium areas are being investigated in Nyasaland. New Consolidated Gold Fields is exploring near Mwanza and the Atomic Energy Authority and the Rhodesian Selection Trust are operating on the southern shore of Lake Nyasa investigating old beach sands containing some monazite and 59% ilmenite and magnetite. Also, many "week-end prospectors" are taking government courses and going investigating on their own with Geiger counters.

Koepe hoists are going into two more major gold mines to help handle the increased rock tonnages. Both mines are increasing capacity to 150,000 tpm. Buffelsfontein G.M. in the Klerskdorp going from 100,000 tons and its neighbor, Stilfontein G.M., upping it from 90,000.

Work on the establishment of the new Mangula copper mine in the Sinoia district of Southern Rhodesia at an estimated cost of $10.8-million is proceeding well. The project is controlled by the Messina Transvaal Development Co.

Mangula is the largest copper mining project in Southern Rhodesia; it is expected to be producing 10,000 long tons of refined copper a year by 1959.

A geological survey of Africa will be made over the next few years by research fellows and students from the University of Leeds, England, under a £100,000 grant from Oppenheimer. Professor of geology W. Q. Kennedy heads program.

Columbium will be produced in Uganda and perhaps also Northern Rhodesia. The Rhodesian deposits are still in the stage of being explored—the deposits are on Nkumba Hill, west of Isoka—but the Uganda Development Corp. has already completed plans to exploit, with a U. S. chemical corporation and a Canadian mining firm, the stores in the northern part of the country. The U. S. is currently buying up the heat-resistant jet-engine alloy for around $33,600 a ton.

IN EUROPE

AUSTRIA

Output of French-Austrian owned Veitscher Magnesit Werke A.G., Veitsch (Carinthia province, Austria) amounted to 430,000 metric tons of raw magnesite during 1955. On this basis, a 60-year production is assured by recent prospecting work on 3,575.2-acre lot. Drilling to 150 m and more, however, revealed raw magnesite of various quality and in such volumes that a 200-year mining period seems assured.

Beryl crystals have been found again in Neumarkt (near Linz), upper Austria province. A number of offers from do-

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- each drying approximately 20 tons/hr. of copper sulphide concentrates . . .
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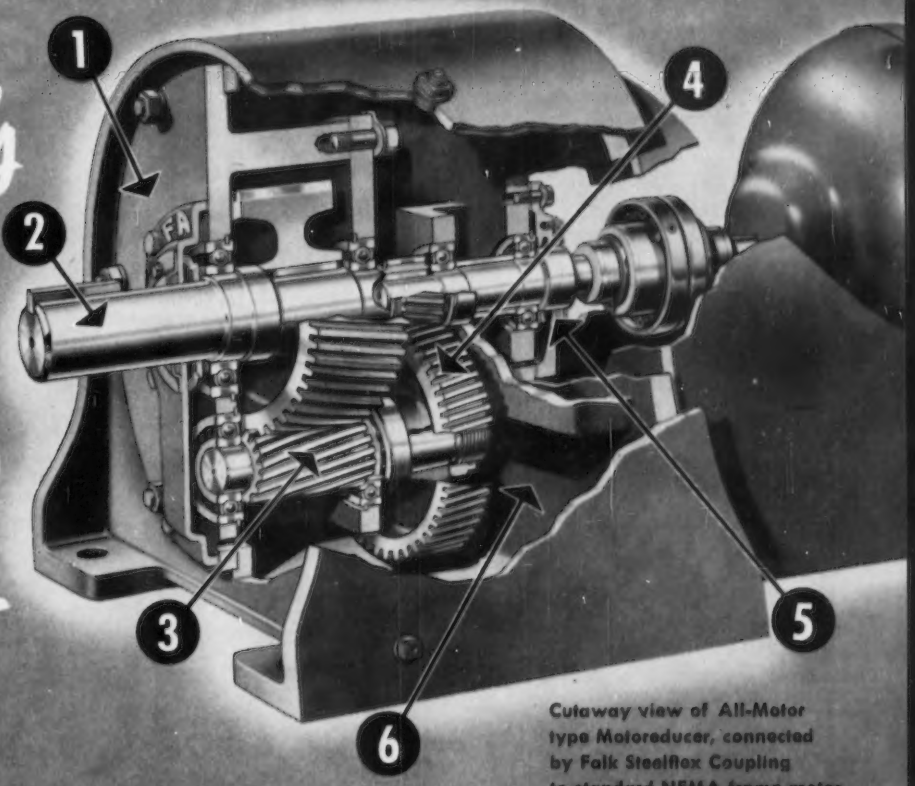

Cutaway view of All-Motor type Motoreducer, connected by Falk Steelflex Coupling to standard NEMA frame motor

WHY Falk Motoreducers give better service—have longer life

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5 **SEALED HOUSINGS.** Splashproof, dustproof, oil-tight construction. Dual closures and one-way vents keep oil in, dust and moisture out.

6 **POSITIVE LUBRICATION.** Large sump capacity...oiltight construction assures clean lubricant...revolving elements lubricated by direct dip.

When you buy or specify the All-Motor type FALK Motoreducer, you get all these—plus the tremendous advantage of full interchangeability of motors. Switch motors as desired—use any make, style or type of standard foot-mounted motor within the unit's AGMA rating—with a minimum of difficulty or "down time."

Available in sizes up to 75 hp—*with or without motor*—from convenient factory, field or distributor stocks, from coast to coast. **Write for Bulletin 3100.**

60,000 HOURS WITHOUT A FAILURE!

Sixty thousand hours is a lot of hours—but the FALK Motoreducer in the unretouched photo above has served that long without failure or need of repair.

This 3 hp unit is one of over 60 FALK Motoreducers in daily service in an Eastern plant of a large milling company, whose president says, in part:

"One of the main advantages of FALK Motoreducers is their adaptability to any motor. Reducers and motors can be easily interchanged....Our service records confirm the wisdom of our choice of FALK equipment as our standard."

FALK ...a good name in industry

THE FALK CORPORATION, MILWAUKEE, WISCONSIN

MANUFACTURERS OF

- Motoreducers
- Speed Reducers
- Flexible Couplings
- Shaft Mounted Drives
- High Speed Drives
- Special Gear Drives
- Single Helical Gears
- Herringbone Gears
- Marine Drives
- Steel Castings
- Weldments
- Contract Machining

Austria *(Continued)*

mestic and foreign mining companies have been received by the owner. Large-scale mining operations are not being planned, however, since the land owner has stressed his intention of mining the lot himself.

BULGARIA

Officials announced on April 26, 1956 that fluorite requirements are covered for many years to come, since a rich deposit of fluorite has been discovered near Michalkovo, Devnja district. Last fluorite in Bulgaria was mined last year, creating the need for imports.

On May 27, 1956, a Sofia despatch stated that a rich iron and manganese ore deposit had been located near Kremikovzi, Sofia district. Located at the Stara Plania River, this deposit yielded siderite of good quality after difficult mining work which had to pierce the siderite-covering limonite seams.

Czech iron ore mining is to increase by 18.5% during 1956 (as compared with 1955). In a successful two-year geological exploration work a number of new deposits of iron ore were discovered, according to Prague claims.

DENMARK

Since the opening of the exploitation of the bog iron deposits in South Jutland (1951) and up to 1956, total exports of iron ore have amounted to 600,000 tons ore, of which 106,000 tons were exported in 1955. Production was divided between hard iron which was sent to the iron works in the Ruhr (Western Germany), and ochre ore which is used as gas purifier, and which was exported to Great Britain and to other Scandinavian countries. The total value of the exports may be estimated at DC 18-million ($2.6-million). 1956 exports will probably reach same quantity as 1955.

Some ore has particularly high manganese contents, and a few years ago it was decided that ore containing more than 10% manganese must not be exported. This quality of ore is used in the production of manganese sulphate, a fertilizer and feed supplement. Annual consumption in this country is of about 800 metric tons, and excess production (annual output of 1,500-2,000 tons) is available for exports.

Present deposits still have about 50,000 tons manganese ore, so that activity of the factory is secured for next 10 years. It is reported that the possibility is being considered of mining this ore as quickly as possible and storing it for future production. Reason is that the bog iron may be destroyed by draining of the soil

SHOWDOWN WITH MINING COSTS:
Gismo promises big new economies!

IT MAKES POSSIBLE a mining method requiring few machines, few men, less planning and integration—permits total mechanization of your mine. Here's a self-loading transport that is SIMPLE, versatile—mucks in development or production, drills, makes its own roadways, etc. Without question, the extraordinary economies the Gismo Method promises merit thorough investigation by any firm excavating rock or its equivalent. Ask us for complete information. *Sanford-Day Iron Works, Inc., P. O. Box 1511 . . . Telephone 3-4191, Knoxville, Tennessee.*

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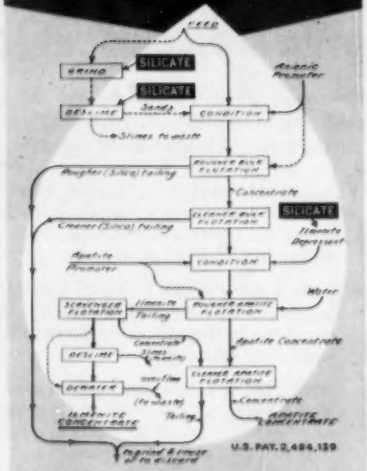

PQ silicates are efficient aids in complex processes of mineral separation. For example, ilmenite, fluorspar, etc. Silicates serve both as depressants and cleaners.

Ask for information about PQ silicates for improving ore recovery economically.

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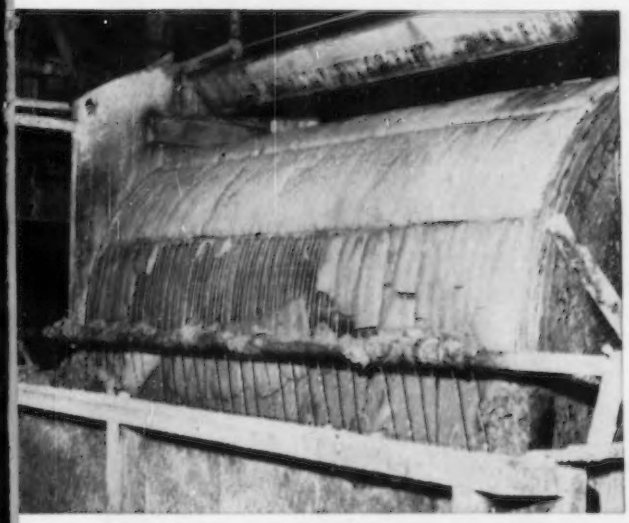
"We couldn't operate without Stainless Steel"

SAYS J. S. MITCHELL, PLANT MANAGER
CALERA MINING COMPANY, GARFIELD, UTAH



Vacuum drum filters—made from Stainless Steel.

This is the nation's largest cobalt refinery. The plant, opened in 1952, has gained fame because of the unique process employed.

The refining process involves leaching with a solution of sulfuric acid. The plant operates 'round the clock, seven days a week. And *fifty percent* of the process equipment is made from Stainless Steel, Type 316. According to Plant Manager J. S. Mitchell, "At our acid concentrations, Stainless Steel holds up at temperatures as high as 200 degrees Fahrenheit."

Only Stainless Steel combines so many useful properties: corrosion resistance, surface smoothness, strength and weldability. Think of Stainless when you plan. Think of *USS* Stainless when you buy.

Stainless agitators maintain concentrates in suspension.

The pure cobalt. It's worth $2.60 a pound.

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UNITED STATES STEEL

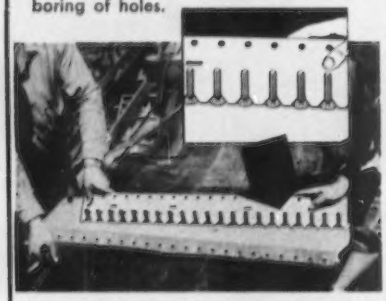
NEW

FLEXCO POWER TOOLS

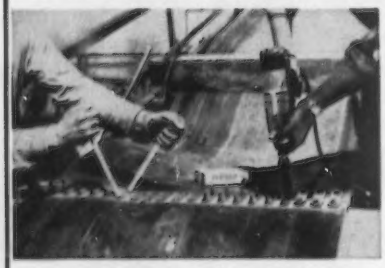
CUT APPLICATION TIME IN HALF

Your two man belt team can now join a belt 30" wide in 15 to 20 minutes . . . using the new FLEXCO Power Tools.

The FLEXCO Power Tool Boring Bit used with electric or air impact tool speeds boring of holes.



New FLEXCO Templet positions bolts for quick joining of belts. Reaching under belt has been eliminated.



Running down nuts is fast with the new FLEXCO Power Wrench used with electric or air impact tool. Two Bolt Breakers are used together to complete the joint.

If you are interested in speeding up fastener application, order the new Power Tools from your local FLEXCO Distributor. Write for Bulletin F-112-A.

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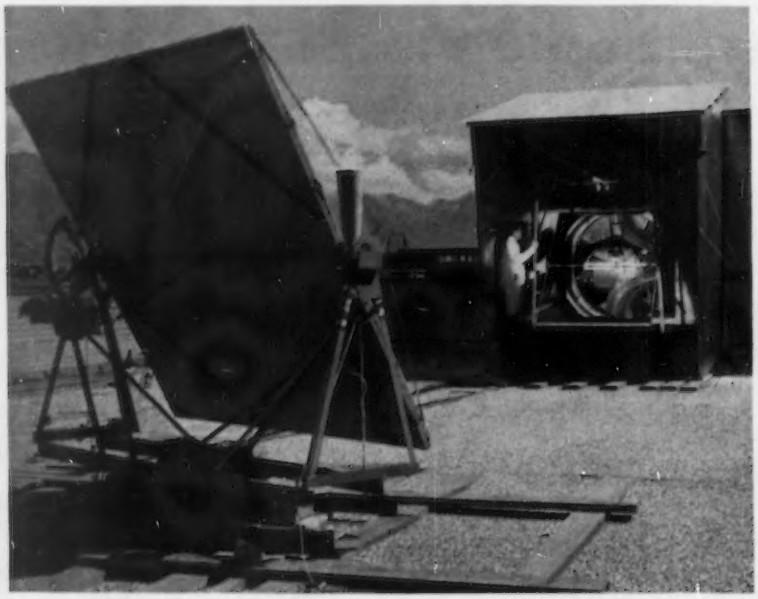


DR. TUDENHAM inspects the furnace. Heliostat is at left foreground.

Kennecott Builds Novel Solar Furnace for $1,000

FOR ABOUT $1,000, Kennecott Copper Corp. has devised a unique solar furnace at its Western Research Center. It produces temperatures of more than 5,000 deg F. A comparable device producing temperatures at this range and under needed metallurgical conditions would cost upwards from $25,000, S. R. Zimmerley, director of the center, estimated.

Smaller mining companies and metallurgical firms can duplicate the Kennecott device at relatively small outlay of capital, officials say.

The solar furnace was devised by Dr. Marvin Tudenham, director of special studies at the research center located on the campus of the University of Utah. It presently is being used in metallurgical research on copper and columbium.

In a conventional solar furnace using a search-light principle (directly focusing on the sun) and the parabolic mirror, a high center of focus results, which necessitates the crucible being held in an upside down position in order to receive the concentration of sun rays. The material eventually melts and runs out of the crucible.

By employing flat mirrors with the parabolic mirror, this problem is eliminated in the Kennecott furnace, Zimmerly says.

The Research Center furnace has four basic parts:

First the sun's rays are captured on a 7x7-ft mirror called a "heliostat." The mirror, which moves as the sun moves, directs the rays on another flat plate glass mirror which is 5 ft wide and 7 ft high and tilted at a 45-deg angle.

This latter mirror transfers the beams of the sun upward on a parabolic mirror about 5 ft in diameter.

It is this instrument which, like a Boy Scout's magnifying glass, concentrates or focuses light or heat—directing it downward to the spot or focal point ⅜-in. in width.

The heat at this focal point, between the parabolic mirror and flat, 45-deg angle mirror, melts the metal in the crucible.

A photoelectric cell, aimed from the edge of the parabola down to the mirror beneath, controls the horizontal and vertical movements of the heliostat so that the sun is always harnessed for research.

Heat is controlled in temperature degree by controlled raising or lowering of a screen or curtain in front of the 45 deg angle mirror.

Assisting Dr. Tudenham in the development was Rex E. Lewis, a center researcher. Lewis was instrumental in perfecting the electronic system which controls the heliostat movement.

Dr. Tudenham will present a paper on the new furnace at a forthcoming meeting of the International Solar Energy Assn. at Phoenix, Ariz. He lists the value of the furnace as follows:

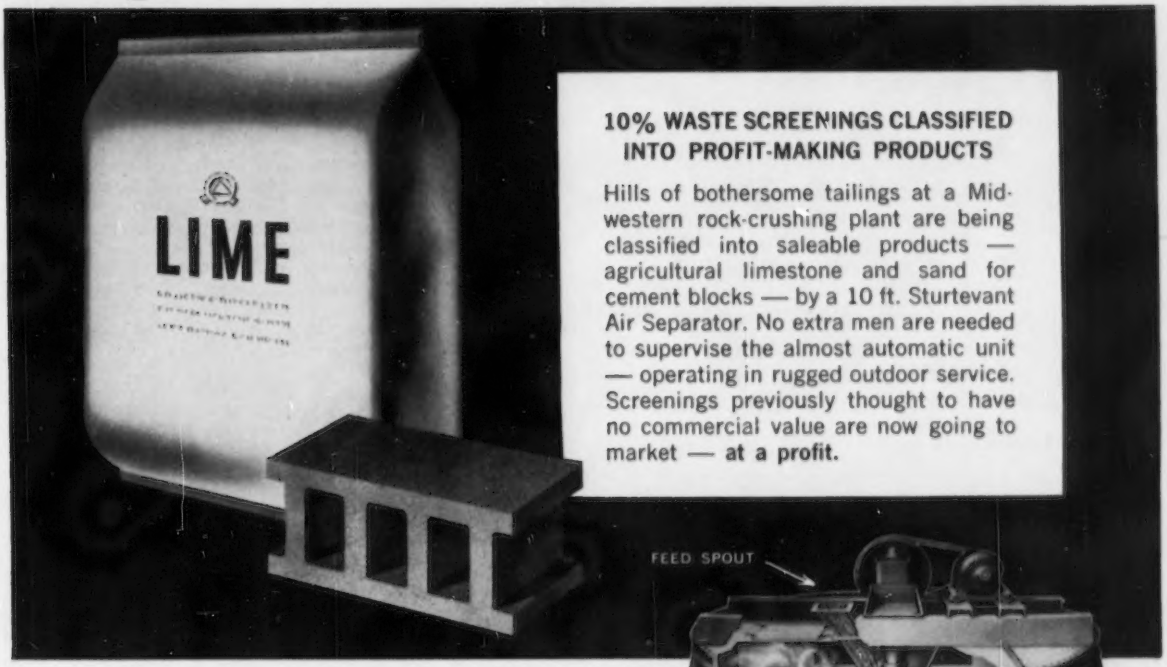
1. Inexpensive source of very high temperature heat.
2. Heat free from contamination of electrodes as is case in arc furnaces.
3. Controlled atmosphere within which oxygen, nitrogen and dust-free experiments may be conducted:
   A. Experiments are accomplished through use of a Bell jar from which air may be evacuated and vacuum formed.
   B. Through replacement of air in Bell jar with helium, etc. or other inert gases.
4. Melting of metals and materials in an upright crucible.

Denmark *(Continued)*

and other measures for improvement of the soil for agricultural purposes.

New deposits have been found in other places in Jutland. Geologists have

Tailings Go to Market - Separated by Sturtevant



10% WASTE SCREENINGS CLASSIFIED INTO PROFIT-MAKING PRODUCTS

Hills of bothersome tailings at a Mid-western rock-crushing plant are being classified into saleable products — agricultural limestone and sand for cement blocks — by a 10 ft. Sturtevant Air Separator. No extra men are needed to supervise the almost automatic unit — operating in rugged outdoor service. Screenings previously thought to have no commercial value are now going to market — **at a profit.**

THE SEPARATOR THAT UPPED 40 TO 400 MESH OUTPUT AS MUCH AS 300%

Sturtevant Air Separators range from 3 to 18 ft. in diameter: deliver fines from 40 to 400 mesh at rates as high as 65 tons per hour . . . in the cement industry, have a tested record of increasing mill capacities from 25 to 300% while lowering power consumption as much as 50% — when used in closed circuit with grinding mills.

Designed to cut costs and build profits, Sturtevant Air Separators give a lifetime of high-efficiency, low down-time service. Rugged construction plus easy accessibility for quick maintenance (typified by the "Open-Door" design in other Sturtevant equipment) assure more output per machine year.

Write today describing your problem. Please include information on material, process and desired capacity.

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Controlled centrifugal whirl by balancing forces separates rapidly, efficiently, cement, lime, clay, talc, ceramics, refractories, phosphates, coal and many other materials. Also used for selection of pigments, limestone, fillers, plastics, oyster shells and abrasives. Write for Sturtevant Bulletin No. 087.

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THE ATLAS CAR & MFG. CO.
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Denmark *(Continued)*

found deposits of about 300,000 tons in one place, and it is estimated that 1/3 of this contains manganese.

A new lead find in northeast Greenland has been reported by a member of a Danish expedition at present making geological investigations.

According to an unofficial report by members of the expedition, lumps of several hundred kilos each of almost pure lead were found on the surface near Lake Lummon about 50 km from lead mine at Mestersvig, while digging produced several tons of almost pure lead.

Nordic Mining Company, holding concession for lead mining in Greenland, declined to comment on report. Company spokesmen said they had several prospecting teams working in the area and that several deposits were known. However, it would take a year or more before anything definite could be said as to the value of these deposits.

EIRE

Five diamond drilling rigs brought from Canada to the Republic by Can-Erin Mines Ltd. are now in operation on various properties. Heaviest rig, capable of drilling to a depth of 3,000 feet, is being used to intersect high grade copper zone below the deepest working in Allihies Mines at West Cork. A second rig is in operation in the same workings.

Two additional surface drills have gone into operation at Beauparc, County Meath, copper mines, owned by responsibility of Irish Mining Corp., Can-Erin's subsidiary. Dewatering continues on Beauparc site as well as Allihies.

Referring to Allihies Mines, an official of Can-Erin disclosed that it was now evident that former operators of these mines were interested solely in high grade. He said that samples of rock used as foundations for buildings contained better than 4% copper.

The Eire Minister of Industry and Commerce stated in Parliament that he received proposals for exploratory work at the old copper mines in Boumahou, County Waterford. He added that he decided to grant facilities to certain interests in respect of these copper deposits, subject to certain conditions. Negotiations with the applicants were still proceeding.

Meanwhile, it is understood that the application came from St. Patricks Mines Ltd., a subsidiary of the Mogul Mining Corporation of Toronto, which is at present exploiting the copper deposits at Avoca, County Wicklow.

FINLAND

Finland's new vanadium plant at the Otanmäki Mine has started production. For the first year it is expected to produce about 300 tons. Subsequently, this figure will be doubled. Ilmari Harki, managing

7 years' trouble-free service on HCL acid with this Crane diaphragm valve

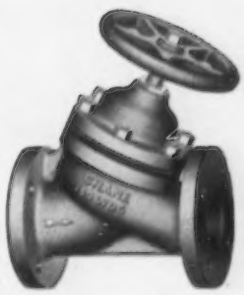
How do Crane diaphragm valves perform on acid services?

This major container manufacturer has impressive proof. Seven years ago, the Crane 4-inch No. 1615-RN rubber-lined diaphragm valve shown above was installed on 17 deg. Baume hydrochloric acid service. The acid is used to clean evaporators and surface condensers. *Not once has this Crane diaphragm valve failed to function—not once has it failed to hold tight.*

Previously, this plant used conventional all-metal valves. These had to be replaced regularly as an expendable material. The Crane valve has eliminated all replacement costs by providing maintenance-free performance—and from all appearances will continue to do so for years to come.

You just don't get service like this from ordinary valves. Crane valves are so expertly designed, have such quality materials and are so carefully machined and tested that cost-free records like this are the rule rather than the exception with Crane users.

Get the facts on Crane diaphragm valves from your local Crane Representative, or write to address below.



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Fast Water Pump Conversion.
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Finland *(Continued)*

will be doubled. Ilmari Harki, managing director of Otanmäki Inc., says that this makes Finland the first real producer of vanadium in Europe.

Harki said that contracts have been signed with West Germany, Sweden, France, Austria and Czechoslovakia.

Vuoksenniska Inc., a Finnish corporation with iron and steel works, is investigating two iron ore fields: 1) in the Aaland Islands, near Nyhamn, and 2) in the archipelago off Tammisaari, on the coast southwest of Helsinki, specifically near the island Jusarö. Both fields, according to the company, look promising, and both the areas being explored are under-water fields, which complicates the issue.

In Nyhamn field the company has used specially-constructed under-water magnetometers and has taken under-water samples with hollow charge bombs. Samples show an iron content of about 40%. A shaft will be sunk vertically this summer from a tiny island to 340 meters. From the bottom, a tunnel will be run out under the sea for about 2,000 meters. Sea is 60-120 meters deep here, and deep sea divers have been used to get the samples. Main difference between this field and the Vabana mine of Newfoundland is that the ore seams in the Nyhamn field, as in most of Fenno-Scandia, are vertical.

In Jusarö field, prospecting has not advanced as far yet as in the Aaland Islands. Here the sea is about 35 meters deep and frogmen from the Norwegian firm, Underwater Service, have been used to obtain samples. There are old mines in this area, but they are exhausted. The company will start diamond drilling this year on Jusarö.

FRANCE

A promising deposit of uranium has been discovered in the Department of the Haute Vienne, not far from the Limoges, France. This is in the neighborhood of Cronzille where a uranium mine is already being exploited.

Societe et Metallurgique de Penarroya, the important French mining concern, is to exploit, together with the Iranian State Planning Organization, lead mines in the North of Iran near Lakhan, according to Paris reports.

A joint Franco-Iranian company has been established for this purpose with a capital of $1.12-million, of which the French group has subscribed 49%.

NETHERLANDS

An agreement for joint search for bauxite deposits as well as for joint exploration and mining of such deposits has been reached in the Hague by the firms Olin Mathieson Chemical Corp., New York; Vereinigte Aluminum Werke AG., Bonn; Aluminum Industrie Aktiengesellschaft, Lausanne, and Billiton Maatschappij, the Hague.

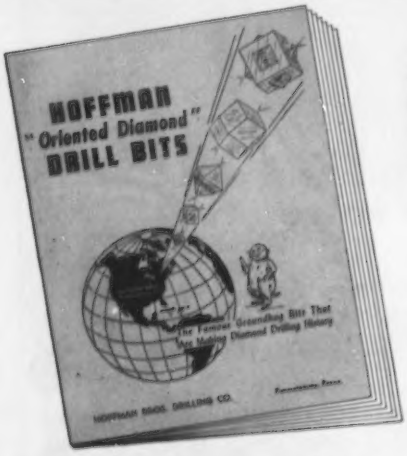
HUNGARY

Hungary will emphasize the output of bauxite and aluminum earth much more than the output of crude aluminum, according to the current Five-Year Plan (1956 to 1960). Hungary is to supply both bauxite and aluminum earth to the other East Block (Soviet satellite) countries, even though Western Europe experts state Hungary's electricity output is insufficient as of now.

Since the close of World War II, Hungary has enlarged two alumina factories at Ajka and Magyarovar, and has also newly commissioned Alma-Fuezitoe. Latter is claimed to be largest works of its kind in Central Europe.

Bauxite of best quality is being processed at present in these three plants, whereas bauxite of poorer quality is being exported to East Germany, Poland and Czechoslovakia. Magyarovar plant, however, has worked since 1952 on development of new methods for processing low-grade bauxite at home.

These experiments aim at utilizing 50% of the alumina and lye remaining in the red mud. While the remaining red mud with its 12% titanium and 45 to 50% iron could be well used in blast



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See how Hoffman Research is producing many other, almost unbelievable advancements in bit design like the Tapered "Step Core" and Miniature Bits shown here. The new Miniature Bits are reducing prospecting labor and costs because they operate from light, ¼ h.p. rigs. By combining drilling and reaming into one operation, the "Step Core" Bits penetrate faster—simplify core recovery—have high speed water release. Yes, it will pay you to find out why so many other drillers are getting better cores, lower footage costs and faster penetration with Hoffman "Oriented Diamond" Bits.

Hoffman Drilling Crews are also available for fast, efficient service on Contract Drilling Jobs.

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AMSCO® hardfacing cuts digging costs

On heavy digging jobs, power-shovel dipper teeth and dipper lips take rough punishment. Rounded off edges and teeth lead to wasted power, slower operation and smaller loads . . . resulting in increased digging costs.

Amsco has the answer to your dipper wear-problems!!

Hardfacing of teeth and dipper lips with *extra tough* Amsco hardfacing alloys can greatly increase service life, improve production operations, reduce power consumption.

For best results with Amsco Hardfacing Electrodes, the weld deposit should be not less than 3/16" in thickness, applied in a thin layer of weld over the parent metal, followed by a heavier layer to the desired dimensions. This will assure an even, flat bead without porosity. See illustrations for proper positioning of hardfacing deposits on dipper teeth and lips.

For full information on proper hardfacing methods and materials, contact your Amsco Welding Distributor. Or write to American Manganese Steel Division, Welding Products, Chicago Heights, Ill.

Dipper teeth and lips showing proper weld deposits with Amsco Hardfacing and Amsco Manganese Steel build-up.

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Hungary *(Continued)*

furnaces, thus solving the Hungarian titanium problem.

WEST GERMANY

Aluminum production for the first half of this year hit 70,442 tons of the virgin metal—almost 3,000 tons more than the total for the first six months of 1955. The government attributes the increase to "rationalization measures."

Another 12,000 tons capacity will be added soon when the Grevenbreich smelter begins operation, powered by a new brown-coal fired power station designed to provide electricity at a lower cost than is possible with any coal-fed generating system now in operation in the country's aluminum industry.

Although no definite agreements have been reached as yet, a result of recent visit of German Atomics Minister, Franz Josef Strauss, to Spain, it is expected that discussions about German participation in mining of Spanish uranium ore will continue and may have favorable results.

Germany is interested in obtaining foreign uranium ore of higher grades (such as it is found in Spain) which, if mixed with rather poor German finds, would make uranium processing more economical.

Chances are that German firms will take part in building and operating uranium ore mines in Spain by providing machinery and trained specialists. These joint enterprises would be in the hands of German-Spanish companies for which Germany would supply capital goods while Spain would provide labor and capital (according to Spanish laws, foreign financial participation is possible only up to 50%). Processing of the concentrate could take place in Germany; part of the processed material might eventually be returned to Spain.

First step towards such German-Spanish cooperation is Strauss's offer to train two Spanish scientists at the planned reactor research center in Karlsruhe. This is reportedly the first German offer of this kind.

SPAIN

Work has begun on the construction of a zinc smelter at Cartagena, according to Spanish press reports. The smelter will be run by a new company, formed last April by the Celdram S. A. Mining Co., the Banco Central of Madrid, and other financial groups.

The smelter is said to be able to convert some 150,000 tons of sulphide zinc ore into 40,000 tons of zinc a year when in full production, half of it by electrolytic process.

In the past, Spain has only processed zinc oxides, while zinc sulphides were exported to countries which supplied Spain with the metal.

Spain has authorized Lithium Corp. of America to participate to the extent of 40% in a new Spanish company which it will set up in collaboration with the Spanish concern, Titania SA of Lalin. The new venture will exploit Titania's lithium ore reserves at Lalin, near Pontevedra.

Under Spanish law, participation of foreign capital is in domestic industrial enterprises normally limited to 25%. However, a higher participation is possible in special cases, on application to the Ministry of Industry.

Empresa Nacional del Aluminio, an undertaking of Spanish National Institute of Industry (INI) and a group of industrialists connected with the Banco de Bilbao, have applied for Government permission to set up at San Balandran (Aviles) a new plant for producing virgin aluminum, alloys, shapes and wire, with an initial annual output of 15,000 tons. All machinery and electrical section will be built in Spain. Imports will be limited to raw materials unobtainable locally,

NEW DEVELOPMENTS

and Techniques in the treatment of Non-Sulfide Ores and Mineral Products are used in Our Laboratory.

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Send for Bulletin 556.

The NEW "Longstick" Bag

Model 360, pouch type bag, was developed to carry the new long length sticks of explosives which are used in some mines and quarries. ABC Bags also made to your requirements.

Made by the manufacturers of Mine Vent and Neolon Flexible Ventilation Tubing

A B C AMERICAN BRATTICE CLOTH CORP.

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A Bucyrus-Erie 3-yd. 71-B, like this one loading uranium ore near Laguna, N.M., offers many advantages for keeping costs in line.

Keep a tight lid on costs with a Bucyrus-Erie 71-B

A good place to begin holding down costs is in the pit, and a good way to do it is by using a Bucyrus-Erie 71-B. This 3-yd. shovel with its perfect balance between speed and power, plus smooth, instant-acting controls, works fast and easy. High speed dig-swing-dump cycles keep output at a high level.

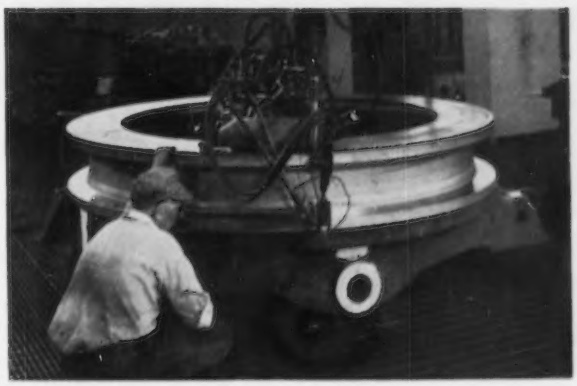
You get maximum working time, too, because there's a minimum of maintenance required. Machinery arrangement is simple with parts easily accessible for servicing. Adjustments are easy to make and *last* once you make them. Lubrication fittings are easy to find, easy to reach.

Your Bucyrus-Erie distributor can give you the complete story on shovels and draglines from ⅜- to 4-yd. capacity. See him soon. For information on larger size machines, write direct.

298E56

BUCYRUS ERIE

SOUTH MILWAUKEE, WISCONSIN



Bonus Quality is the result of extra care in the manufacture of Bucyrus-Erie equipment — like the carefully controlled flame-hardening of a truck-frame roller path by this automatic machine to insure low maintenance and long life.

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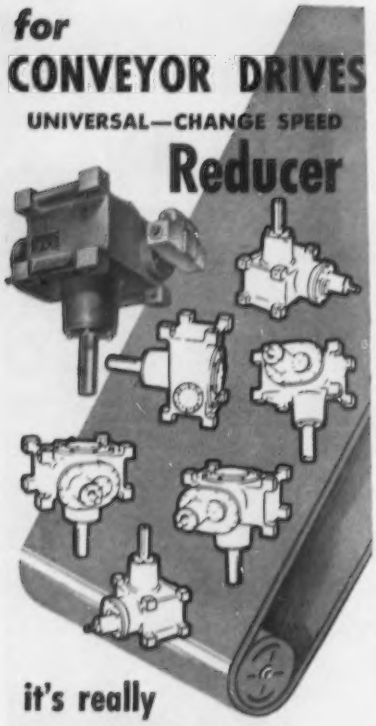
CONVEYOR DRIVES
UNIVERSAL—CHANGE SPEED
Reducer



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can be mounted in any of the above positions

The HVUT Units not only offer you complete flexibility of mounting, but very easy change of output speeds—within a matter of minutes, the Helical gear chamber can be opened and gearing replaced to give exact speed change desired. Two separate helical gear sets form the high speed reductions, while the slow speed reduction consists of heavy-duty worm gearing. All gears, bearings, shafts and housings are of the very finest materials, to assure you of efficient, trouble-free, long-lived performance. Another feature—all Units are equipped with the famous Philadelphia "Dry Well" construction which assures a completely dry area around the output shaft, even when the shaft is mounted in a "shaft-down" position.

HVUT Reducers are rugged and absolutely dependable Units, designed and built by one of the Pioneers in Industrial Speed Reducers. They are the ideal drives for most every type of Conveyor, including trolley, floor and pit types—and remember, the HVUT Units are available at low initial cost.

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See the newest developments in Mechanical Power Transmission at our Booth 2280—22nd National Power Show, New Coliseum, New York City, November 26-30.

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Spain *(Continued)*

such as calcinated alumina, cryolite and others.

YUGOSLAVIA

The Soviet Union, East Germany and Yugoslavia will take part—according to a recent, Moscow-signed treaty—in building a Yugoslavian aluminum factory of 100,000 metric tons annual capacity The construction work is to start this year.

Soviet Union and the German Democratic Republic are to extend 7 million rubles ($1.75-million) credit each, based on low-interest rate and on long-term repayment. The repayment is to be made by Yugoslav rolled aluminum goods deliveries to the respective countries.

IN ASIA

JAPAN

The Japan Mining Association will shortly decide whether to accept a recent Bolivian request for 20 Japanese experts on nonferous metal mining. The plan, if materialized, will constitute the first case of Japanese technical aid extended for the development of mineral resources to a South American country.

The Bolivian request for 20 experts is connected with an earlier proposal from that country for cooperation of the Japanese nonferrous mining industry in the development of tin, copper, zinc and other mineral resources. The proposal, made last spring, offered either a commission refining formula or establishment of a joint refinery in Bolivia.

Three Japanese mining companies—Japan Mining, Toho Zinc and Toyo Mining—have sent investigators to Bolivia for an on-the-spot survey.

INDIA

Indian Copper Corp. Ltd., operating in the State of Bihar, reported that ore reserves dropped to 3,330,000 short tons, 2.49% Cu. They showed a net income £1,474,804 from metals and minerals refined. Copper production amounted to 7,281 tons refined metal and 5,769 tons of brass mill products. Sales during the year amounted to 10,791 tons ignot and products. Company reported an increase in operating costs attributed to rise in labor and material costs.

Indian Government, which had asked its British consultant engineers to prepare a preliminary project report for Madras State's $147-million lignite-mining scheme at Neiveli, now has decided to go ahead with the project's first phase by placing a $5.5-million order for mining equipment. Where the order has gone still has not been revealed but it is considered likely here that East Germany, which helped at the initial exploration and

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It's the Allison FourSpeed TORQMATIC DRIVE—a torque converter, transmission and retarder in *one* compact unit.

And this headline-making drive does more than fulfill a driver's dream as he puts this International Harvester 24-ton Model 95 Payhauler through its paces.

It speeds trips and job-cycle times. There's no break in the power flow as the driver flicks a lever to switch speed ranges with terrain changes. There's no clutch-pedal pushing, no gearshift-guesswork.

Allison TORQMATIC DRIVE holds maintenance and repair costs down to the minimum. The TORQMATIC converter absorbs shock loads, prevents harmful engine lugging and stalling.

Another exclusive feature of this TORQMATIC DRIVE greatly extends service-brake life, makes driving safer, too. It is the built-in hydraulic retarder which gives this hefty Payhauler a second braking system that saves regular service brakes for full stops or snubbing on curves.

Want to know more about this great new Allison Model CBT-5640 FourSpeed TORQMATIC DRIVE? Write Allison Division of General Motors, Box 894M, Indianapolis 6, Indiana.

Allison

TORQMATIC DRIVES

report by C. B. ARRINGTON MINING CO.

CEDARTOWN, GEORGIA

on their new 1-yd. **LORAIN-50** *shovel*

"Good Machine"

"A good machine . . . everything good," that's the enthusiastic report by C. B. Arrington Mining Co. on their 4th and latest Lorain . . . this 1-yd. "50" shovel, mounted on a crawler 14-ft. long. It is shown working against a 50-ft. face at their Bluffton, Alabama, mine, where the "50" is loading up to 1800 yds. of iron ore per day.

What makes the "50" such a "good machine" for mines like this one? It has all the newest, most advanced Lorain shovel design features combined into a big, fast-producing 1-yd. machine. There's the new 2-Lever, "Joy-Stick, Metered-Air" Controls that make it easy for the operator to boost daily yardage. Full air controls of all crawler operations also are provided.

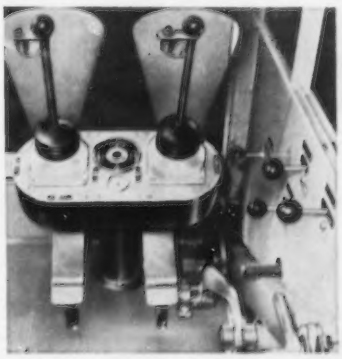
Center-drive application of power permits ganging up full engine power on any one operation, or spreading power in the proper balance over simultaneous and synchronized operations. "No-stall, no-shock" Hydraulic Coupling Power Take-off is standard. Torque Converter available. Swing and hoist shafts are mounted on anti-friction bearings. These are but a few of the highlights that miners are talking about in the Lorain-50 Shovel.

Investigate new and important advances Thew-Lorain has introduced in recent months. There are many innovations in the Lorain line of shovel-cranes, from ⅜ to 2½-yd. size. Get facts you need from your Thew-Lorain Distributor.

THE THEW SHOVEL CO., LORAIN, OHIO

"JOY-STICK" CONTROLS

The Lorain 2-Lever, "Joy-Stick, Metered-Air" Controls are easier, faster, simpler to operate. Gone is the bank of many hard-working levers of yesterday. "Air-Ease" does the work, yet operator retains full normal "feel" of clutches.



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India *(Continued)*

pumping stage, will get a lion's share.

Pumping of subsoil water, which was the major problem, now is complete at a cost of nearly $5-million.

A Norwegian firm, Elektokemisk A/S, Oslo, is helping private Indian enterprise to set up a ferro-manganese plant in the south Indian state of Andhra, with a capacity of 30,000 tons of standard grade high carbon ferro-manganese per year. Other ferro alloys such as low carbon ferro-manganese, silicon, manganese, ferro-silicon, spiegaleisen, ferro-chrome and ferro-phosphorus will also be producted.

The plant, situated about 55 miles from the eastern seaboard port of Vizagapatnam, near the Kodur Main Pit manganese mines, will be run by the new $5.25-million company called Ferro Alloys Corp. Ltd.

According to an agreement, the Norwegian firm will supply the main body of the plant and machinery, the other items to be supplied by Westfalia Dinnendahl Groppel Aktiengesellschaft, Bochum, West Germany (WEDAG). The Norwegian manufacturers also guarantee that the furnaces supplied by them will produce, during a three-shift, 300-working day year, 30,000 tons of ferro-manganese. Payment will be accepted in three installments over 1957 to 1959. In addition, Indian technicians will receive training in Oslo.

To use the low quality ore, readily available nearby, a beneficiation plant will be set up by a subsidiary of the new company, which will upgrade and beneficiate low grade ore for export markets.

The U. S.- and British-sponsored Industrial Credit and Investment Corp. (ICIC) will underwrite the share issue to the extent of $147,000.

KOREA

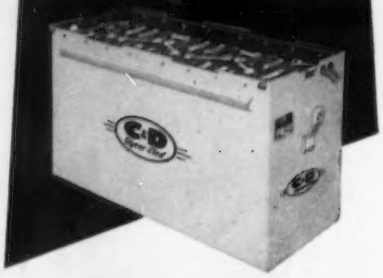
Machinery and equipment to increase output of monazite is being purchased by the Korea Rare Elements Development Co., as a result of a $50,000 loan from the United Nations Korean Reconstruction Agency.

Embedded in the sands of Pi-in on the west coast of Korea, monazite has been isolated and studied by the staff of UNKRA and Korean mining technicians working at the mineral assay laboratory at Taejon. Eight engineers worked for six weeks digging test pits, analyzing samples, and making ore-dressing tests before it was ascertained that the beach contained an estimated 6,250 metric tons of 80% monazite concentrates which would yield an estimated 5,000 metric tons of recoverable monazite.

An extraction process was also worked out which involved the purchase of spiral concentrators and magnetic separators for the Taewha monazite mine. After the new machinery is installed, it will be possible to ship high-grade monazite concentrates to any part of the world.

At present the company produces some 20 metric tons a month of low-grade monazite concentrates.

C&D Slyver-Clad Batteries CUT Hauling Costs



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One of fourteen new Dart Model 25SL, 25-ton end dump trucks, built for the Reynolds Haitian Mines, Inc. Equipped with Cummins NHRBS-600 Diesel Engines, driving through Twin Disc Model CO Torque Converters and Fuller 4MS1440 4-speed Transmissions—the trucks will haul bauxite ore in Haiti.

In building fourteen new Model 25SL, 25-ton end dump trucks for Reynolds Haitian Mines, Inc., Miragoane, Haiti—the Dart Truck Company *standardized* on Twin Disc Model CO, Three-Stage, Truck-Type Torque Converters. This specifically met Reynolds' requirement for a retarding device that would eliminate use of regular service brakes on downhill runs.

These new Darts will carry bauxite ore from the mines located on the plateau above Miragoane, Haiti. The average 8-mile haul (with some as long as 11 miles) is completely downhill, encountering grades varying from 0 to 11%—with an average grade of approximately 5%.

On one of three trucks already delivered to Miragoane—it has been reported that the converter, with its automatic braking, *holds the loaded (97,000 lb.) truck down to 25 mph on an 11% grade.*

Engineered specifically for operations of this kind — the Model CO multiplies torque input up to 6:1. It provides converter downhill hydrodynamic braking action automatically —whenever the accelerator pedal is retarded, by engagement of the new, heavy-duty truck-type 6" freewheel. With this special *built-in* braking feature, braking effort can actually be exerted *up to 90%* of the engine's rated horsepower.

Twin Disc also offers the Model DF Truck-Type Torque Converter, which also features Converter Braking, and Lock-out Drive for flat, straightaway runs, where fuel-saving benefits of direct mechanical drive can be utilized at high speeds.

Whatever *your* operation—short, steep hauls, or longer, straight runs—Twin Disc has a three-stage, truck-type torque converter to *exactly fit your needs.* Write for Bulletin 501-A.

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Torque Converters

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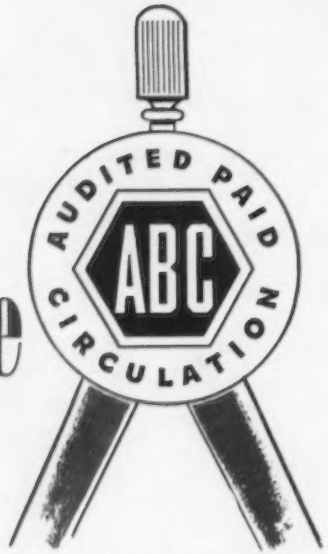

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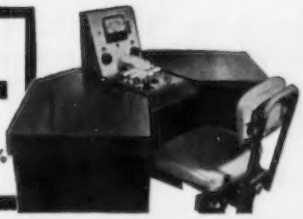

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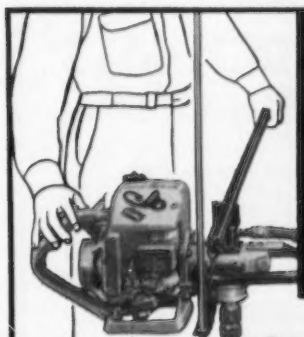

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(Continued on opposite page)

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(Continued from opposite page)

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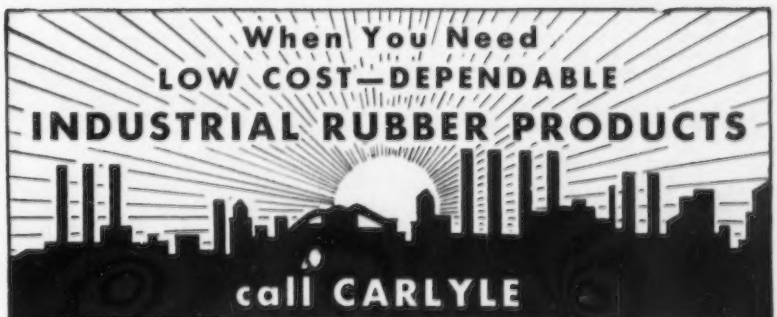

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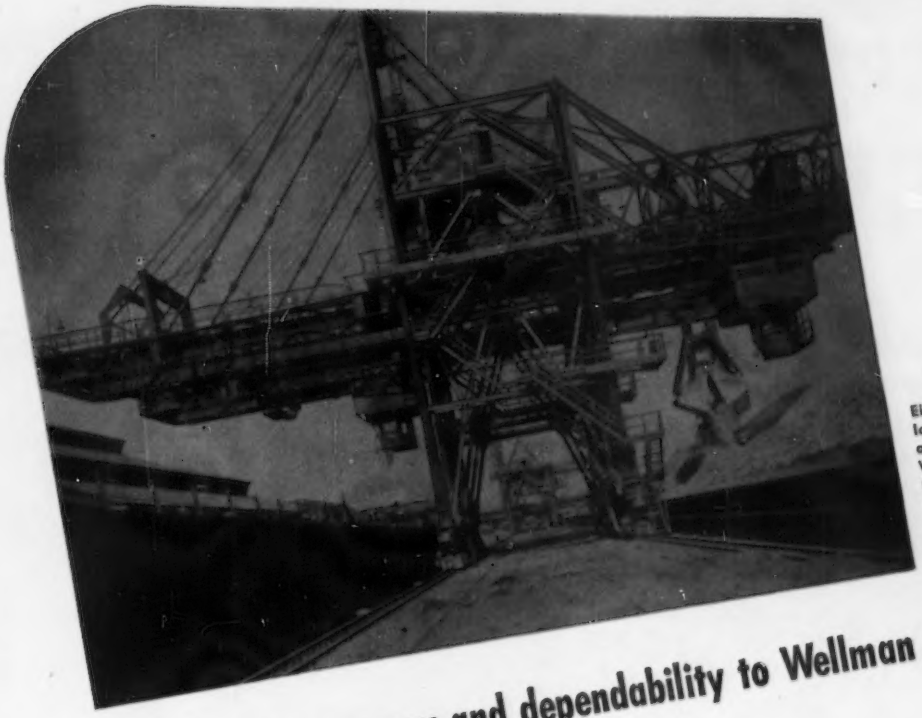

Eighteen compact Cleveland Speed Reducers enable operators of these Wellman ore unloaders to quickly and accurately position the grab buckets over the proper hatch of the freighter alongside the dock.

18 CLEVELANDS give accuracy and dependability to Wellman ore unloaders

FOR 37 years, smooth dependable power transmission for many types of Wellman heavy-duty equipment has been supplied by Cleveland Worm Gear Drives.

On this pair of massive 10-ton iron ore unloaders, 18 Cleveland drives provide a steady, uninterrupted flow of power to the trolleys and driving trucks. So rugged are the trouble-free Clevelands that danger of sudden failure is remote—even if briefly overloaded two to three times their rated capacity.

These Wellman "Work Horses" must be on the job around the clock to quickly unload ore carriers so they can return to the Iron Ranges for another load during the all-too-short Great Lakes shipping season.

Why not let us present the complete story on how Clevelands can dependably and economically handle your power transmission problems? Write today for Catalog 400—it's free. The Cleveland Worm and Gear Company, 3281 East 80th Street, Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers, Limited.

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RIGHT POWER AT LOWER COST

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Excellent though this engine's performance is, the new line of Caterpillar Diesels will deliver even more power with less down time at lower cost. The Cat D318, for example, is ideal for installation in shovels like the one shown here.

Like all Caterpillar Engines, the 4-cycle D318 is compact for easy installation. It is also available with torque converter for smooth power application and ease of operation. It idles without fouling, and runs cleanly and efficiently even on low-cost No. 2 furnace oil, thanks to its tinker-free Caterpillar fuel injection system. And it owes its trouble-free work life to such quality features as "Hi-Electro" hardened crankshaft journals, aluminum alloy bearings, and highly effective oil and air filters.

Leading manufacturers can supply Caterpillar Engines as original power in their equipment. And your Caterpillar Dealer can install one of these rugged 4-cycle diesels when it's time to repower your present equipment. He will gladly advise you on the engine from the broad Caterpillar line that will suit all your mining operations. Count on him, too, for skilled service and factory parts you can trust. Why not give him a call today?

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR*

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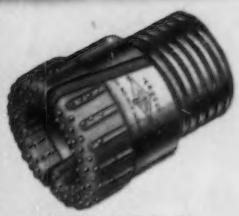
MODERN
HEAVY-DUTY POWER



TRUCO CORING BIT

TRUCO CONCAVE BLAST HOLE BIT

TRUCO PILOT BIT

TRUCO IMPREGNATED CORING BIT

TRUCO REAMING SHELLS

TRUCO STANDARD OIL FIELD BIT

FINEST QUALITY DRILL BORTZ

in the American tradition

Twice a day a quick transformation overtook the old frame garage on John R Street, Detroit. At seven in the morning, the doors swung open, a spindly car chugged out and the garage became a busy little workshop. Some time after dark, the car was driven back in and, for a few hours, the workshop was a garage again.

As a workshop, it had for us a very special significance—it was here that our Company came into being and set up the first local shop devoted exclusively to making industrial diamond tools.

But, far more important, it was the first place in the whole midwest where industry could find a complete stock of fine industrial diamonds, imported direct to Detroit, and superior to stocks previously available only in New York.

Such convenience is taken for granted nowadays and the mails deliver thousands of our diamond selections yearly, but, in those days, it was an innovation and so useful that in almost no time at all, the old frame garage (which had cost $50.00) needed a 12-foot addition (which cost another $50.00).

And, that was but the beginning. Today, our plants are the most modern in the industry and in the intervening 46 years our laboratories have pioneered many of the most significant innovations in diamond tool technology, including *Engineered Diamond Tools** and Truco Engineered Diamond Bits.

And, today, in every major drilling operation throughout the world, Truco Engineered Diamond Bits enjoy a unique reputation for fast, accurate, dependable cutting in any formation and for their ability to deliver important economies in rig time and footage costs. May we send you the Truco Diamond Bit Catalog?

**Engineered Diamond Tools* are diamond tools *engineered* to the job and *guaranteed* to do it.

TRUCO DIAMOND BITS

by

WHEEL TRUEING TOOL COMPANY

3200 W. Davison Avenue, Detroit 38, Michigan

WHEEL TRUEING TOOL CO. OF CANADA, LTD.

575 Langlois Avenue, Windsor, Ont., Canada

DRILL BORTZ

First sheave block to take scraper "round-the-corner" and back

---*turns smoothly on TIMKEN® bearings*

THIS new Pacific Round-the-Corner sheave block is the first method ever devised to take an underground slushing scraper around a corner with a load, then return it around the corner to the muck pile for another load.

To keep the sheaves in positive alignment, Alloy Steel and Metals Co. engineers mount the block on Timken® tapered roller bearings. The *taper* in Timken bearings enables them to take thrust as well as radial loads or any other combination. And full line contact between rollers and races gives them extra load-carrying capacity.

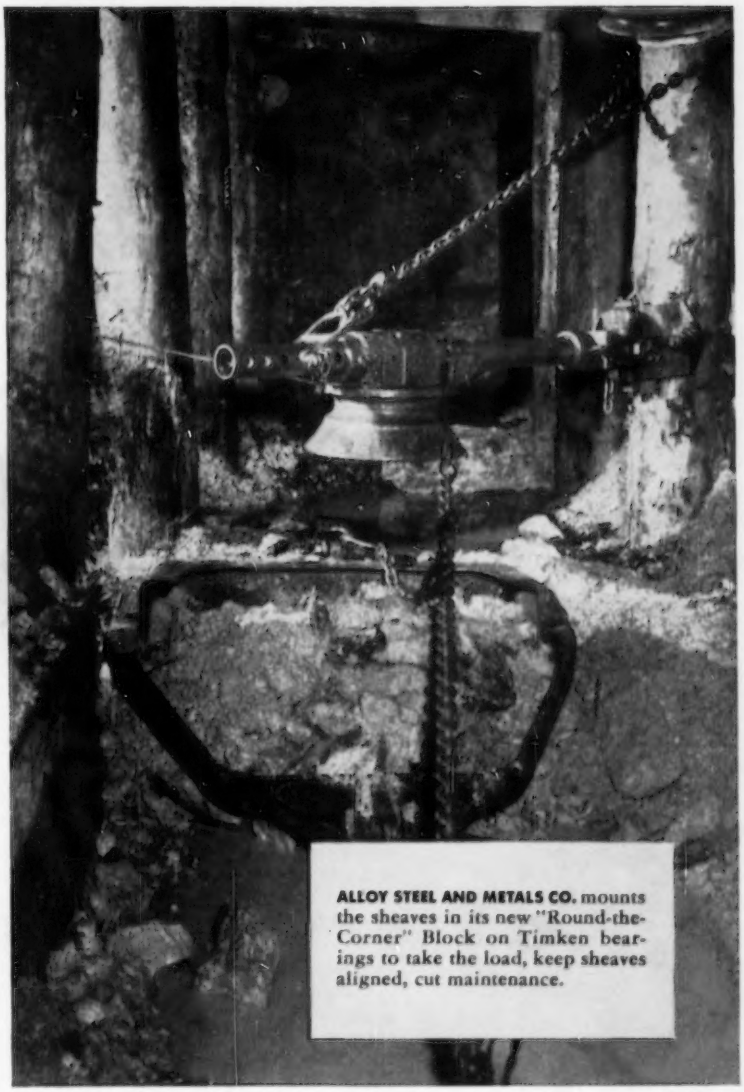
In addition, Timken bearings are almost friction-free. They are designed to have true rolling motion, and precision manufactured to live up to their design. Sheaves rotate smoothly with a minimum of wear.

Timken bearings cut lubrication expense because they keep the block's sheaves concentric with its center pin. Closures are more effective. Lubricant is kept in, dirt and moisture are kept out.

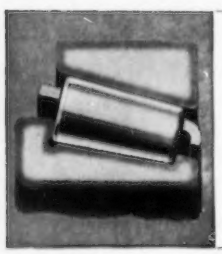
There's another reason why Timken bearings minimize costly underground maintenance for the R-T-C sheave block. Their rollers and races are case-carburized to have hard surfaces over tough cores. The hard surfaces resist wear. The tough cores shrug off shock loads. Equipment stays on the go longer.

The Timken Company is the only bearing manufacturer in America that makes its own steel. No other roller bearings give you so many advantages. Next time you build or buy a machine, make sure the trade-mark "Timken" is on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



ALLOY STEEL AND METALS CO. mounts the sheaves in its new "Round-the-Corner" Block on Timken bearings to take the load, keep sheaves aligned, cut maintenance.



GREATER LOAD AREA

Because the load is carried on the *line* of contact between rollers and races, Timken bearings carry greater loads, hold shafts in line, wear longer.

Only Timken tapered roller bearings have these advantages: 1. advanced design; 2. precision manufacture; 3. rigid quality control; 4. Timken fine alloy steels.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

NOT JUST A BALL ○ NOT JUST A ROLLER ⊂⊃ THE TIMKEN TAPERED ROLLER ⊂⊃ BEARING TAKES RADIAL ⊕ AND THRUST →◇← LOADS OR ANY COMBINATION →✳←